

6. VULNERABILITY OF ESSENTIAL FISH HABITAT TO BOTTOM-TENDING FISHING GEARS

INFORMATION NEEDS AND SOURCES

This section evaluates potential adverse effects of bottom-tending fishing gears on benthic EFH in the Northeast Region. These gears are regulated by the MSA and the EFH final rule, 50 CFR 600.815(a)(2)(i). The EFH final rule recommends that the evaluation consider the effects of each fishing activity on each type of habitat found within the EFH for any affected species and life stage. The EFH rule further recommends that the following information be reviewed in making an evaluation: 1) intensity, extent, and frequency of any adverse effects on EFH; 2) the types of habitat within EFH that may be adversely affected; 3) habitat functions that may be disturbed; and 4) conclusions regarding whether and how each fishing activity adversely affects EFH.

The EFH final rule requires that EFH designations be based on the best available information. This information may fall into four categories that range from the least specific (Level 1) to the most specific (Level 4). These categories are defined as follows:

- Level 1:** Presence/absence data are available to describe the distribution of a species (or life history stage) in relation to potential habitats for portions of its range.
- Level 2:** Quantitative data (*i.e.*, density or relative abundance) are available for the habitats occupied by a species or life history stage.
- Level 3:** Data are available on habitat-related growth, reproduction, and/or survival by life history stage.
- Level 4:** Data are available that directly relate the production rates of a species or life history stage to habitat type, quantity, and location.

Existing EFH designations in the Northeast Region are based primarily on Level 2 information. This level of information is inadequate for making definitive determinations of the consequences of fishing-related habitat alterations on EFH for any species or life stage in the region because the habitat alterations caused by fishing cannot be linked to any known effect on species productivity. Therefore, this section of the document qualitatively evaluates the vulnerability of benthic EFH for each species and life history stage in the region to the effects of bottom-tending fishing gear. Vulnerability is defined as the likelihood that the functional value of benthic EFH would be adversely affected by fishing. Further, given the limited nature of the information available for this qualitative

evaluation, emphasis was placed on the identification of potential adverse effects of fishing on benthic EFH.

Information used to perform these evaluations included: 1) the EFH designations adopted by the Mid-Atlantic, New England, and South Atlantic Fishery Management Councils; 2) the results of a Fishing Gear Effects Workshop convened in October 2001 (NREFHSC 2002); 3) the information provided in this document, including the results of existing scientific studies, and the geographic distribution of fishing gear use in the Northeast Region; and 4) the habitats utilized by each species and life stage as indicated in their EFH designations and as supplemented by other references. In most cases, habitat utilization was determined from the information provided in the EFH Source Documents (*NOAA Technical Memorandum NMFS-NE Issues 122-152, 163, and 173-179*), with additional information from Collette and Klein-MacPhee (2002).

EVALUATION METHODS AND RESULTS

Vulnerability of EFH to bottom-tending fishing gear was ranked as none, low, moderate, or high, based on a matrix analysis of three primary components: 1) benthic life stages of FMP-regulated species; 2) habitat function and sensitivity; and 3) gear usage. The matrix analysis initially ranked each habitat for its susceptibility to disturbance and each gear for its potential adverse effects, and then subsequently combined those two rankings with available information on the habitat usage by species/life stages and the distribution of gear usage, in order to obtain the EFH vulnerability rankings.

These evaluations are summarized in Table 6.1. Note in Table 6.1 that: 1) species and life stages for which EFH vulnerability was “not applicable” are not included; and 2) pots, traps, sink gill nets, and bottom longlines -- to which the EFH of all species and life stages showed “low” vulnerability -- are also not included.

The rationale for these evaluations is outlined by species in Tables 6.2-6.45, and was based on the authors’ following three assumptions. First, the habitat’s value to each species and life stage was characterized to the extent possible based on its function in providing shelter, food, and/or the right conditions for reproduction. For example, if the habitat provided shelter from predators for juvenile or other life stages, gear effects that could reduce shelter were of greater concern than other effects. Second, in cases where a food source was closely associated with the benthos (*e.g.*, infauna), the ability of a species to use alternative food sources (*e.g.*, generalist versus specialist species) was evaluated. Third, since benthic prey populations may also be adversely affected by fishing,

gear effects that could reduce the availability of prey for bottom-feeding species or life stages were of greater concern than if the species or life stages were piscivorous.

The information in Tables 6.2-6.45 includes for each life stage the geographical extent of EFH, its depth range, its seasonal occurrence, and a brief EFH description that includes -- for benthic life stages -- substrate characteristics. The information presented in columns 2-5 of these tables is derived from EFH text descriptions and maps that originally appeared in the NEFMC Omnibus EFH Amendment (NEFMC 1998) and several FMPs prepared by the NEFMC and MAFMC. Additional information, where available, is provided at the bottom of each table to explain the rationale that was used in making the gear-specific EFH vulnerability rankings. EFH descriptions of depth, seasonal occurrence, and habitats (columns 3-5 in Tables 6.2-6.45) are not always consistent among life stages of an individual species. Spawning American plaice adults, for example, are described as occurring from March through June, but their eggs are described as occurring from December through June on Georges Bank (Table 6.2). In addition, the information in columns 3-5 in some cases does not completely agree with the information provided in the rationale.

The rest of this section details the methods that were used to perform the evaluations and assign the rankings.

Life Stages

Five life stages were evaluated: eggs, larvae, juveniles, adults, and spawning adults. Adult and spawning adult life stages were in most cases combined for evaluation purposes due to the difficulty in distinguishing between the two. In some cases (*e.g.*, pelagic life stages that are not vulnerable to bottom-tending fishing gear effects), a vulnerability ranking was not applicable.

Habitat Scoring and Ranking

Habitat rank was determined from four criteria that were qualitatively evaluated for each life stage based on existing information. Each evaluation resulted in a score based on predefined scoring criteria.

The first three criteria were related to habitat function, and included shelter, food, and reproduction. The fourth criterion was habitat sensitivity. Scoring of these criteria was determined as follows:

Shelter (scored from 0 to 2): If the life stage is not dependent on bottom habitat to provide shelter, then it was scored a 0. Almost every life stage evaluated has some dependence on the bottom for shelter, so, with the exception of a few egg stages, 0 was seldom selected. If the life stage has some dependence on unstructured or

noncomplex habitat for shelter, then it was scored a 1. For example, flatfishes that rely primarily on cryptic coloration for predator avoidance, or on sand waves for refuge from bottom currents, were scored a 1. If the life stage has a strong dependence on complex habitats for shelter, then it was scored a 2. For example, juvenile Atlantic cod and haddock, which rely heavily on structure or complex habitat for predator avoidance, were scored a 2.

Food (scored from 0 to 2): If the life stage is not dependent on benthic prey, then it was scored a 0. For example, eggs were always scored a 0, as were life stages that fed exclusively on plankton. If the life stage utilizes benthic prey for part of its diet, but is not exclusively a benthic feeder, then it was scored a 1. For example, species feeding opportunistically on crabs as well as squid or fish were scored a 1. If the life stage feeds exclusively on benthic organisms and cannot change its mode of feeding, then it was scored a 2.

Reproduction (scored from 0 to 1): Limited knowledge of spawning behavior and habitat usage for many species made this the most difficult category to assess. In the opinion of the authors, the available information was insufficient to evaluate this criterion beyond a simple yes or no, resulting in a scoring of 0 or 1 for this factor. While this two-level scoring instead of three-level scoring may have unavoidably undervalued reproduction for some species in the overall scoring, it was decided that this was better than attempting to make finer distinctions that were unsupportable based on available evidence.

A score of 0 was selected for nonreproductive life stages (larvae and juveniles), and for species that are known to spawn in the water column and have only pelagic early life stages. A score of 1 was selected for species where a known association with the bottom exists for one or more aspects of the reproductive cycle.

Habitat Sensitivity (scored from 0 to 2): This criterion does not evaluate the function of the habitat, but instead accounts for its overall relative sensitivity to disturbance. The type of benthic habitat (defined primarily in terms of depth, energy regime, and substrate) inhabited by each species and life stage was based primarily upon its EFH designation.

If a habitat was not considered sensitive to disturbance, then it was scored a 0. However, a score of 0 was not used for any benthic habitat type. If the habitat was considered to have a low sensitivity to disturbance, then it was scored a 1. For example, habitats that are high-energy environments without structural complexity, or that have rapid recovery rates, were scored a 1 (*e.g.*, high-energy sand environments). If the habitat type was considered highly sensitive to disturbance, then it was scored a 2. For example, habitats that are structurally complex (*e.g.*, those supporting epibenthic communities or

those with boulder piles), or that have very slow recovery rates (*e.g.*, low-energy deepwater environments), were scored a 2.

These scores were based on existing conceptual models that show a direct relationship between higher structural complexity of the habitat, longer recovery time, and increased vulnerability to disturbance (NREFHSC 2002; NRC 2002).

Habitat rank was defined as the sum of the scores for the four habitat criteria (shelter + food + reproduction + habitat sensitivity). Another way to characterize the habitat rank is the relative vulnerability of the habitat to non-natural physical disturbance. The habitat ranks ranged from 0 to 7, with 7 being the most vulnerable.

Gear Types, Scoring, and Ranking

Five fishing gear classifications were evaluated: otter trawls, New Bedford-style scallop dredges, hydraulic clam dredges, pots and traps, and sink gill nets and bottom long lines. The pot/trap and net/line gear types were considered to have the least effect of the five gear types evaluated. The panel of experts that met in October 2001 ranked their concerns over effects from fixed bottom-tending gear well below their concerns over the effects from mobile bottom-tending gear (NREFHSC 2002). Based on the limited information available (Eno *et al.* 2001; NREFHSC 2002), the vulnerability of all EFH for all benthic species and life stages to pot and trap usage was considered to be low. Similarly, there is little scientific information that evaluates the effects of sink gill nets and bottom longlines on benthic marine habitats, and none evaluates these effects in the Northeast Region. Consequently, like pots and traps, the vulnerability of all EFH for all benthic species and life stages to sink gill net and bottom longline usage was considered to be low. These rankings should be revisited as more information on gear effects becomes available.

The greatest concern is for the vulnerability of benthic EFH to mobile bottom-tending gears (see Chapters 3 and 4). In the northeastern United States, these gear types include various types of bottom otter trawls, New Bedford-style scallop dredges, and hydraulic clam dredges. Otter trawls are responsible for most of the fisheries landings throughout the Northeast Region, and are used in a variety of substrates, depths, and areas. Scallop dredges are used in sand and gravel substrates. Hydraulic clam dredges are used only in sand, shell, and small gravel within well-defined areas.

Rather than rate the relative effects of these three gear types on EFH, they were treated as having similar effects. The criterion for each gear type was based on the spatial distribution of gear use (scored from 0 to 2) in areas designated as EFH for a given species and life stage. If the gear is not currently used within the EFH area, then it was

scored a 0. If the gear is currently used in only a small portion of the EFH area, then it was scored a 1. If the gear is currently used in more than a small portion of the EFH area, then it was scored a 2.

The spatial distribution of fishing activity for each gear was determined from reports of the number of days absent from port, or the days fishing, for individual TMSs of latitude and longitude during 1995-2001 (see Chapter 4). Maps of TMSs designated as EFH are available in NEFMC (1998) and in various fishery management plans developed by the Mid-Atlantic and South Atlantic Fishery Management Councils, and have not been reproduced for this document.

The gear rank assesses the overall effect on EFH from fishing with bottom trawls, scallop dredges, and clam dredges. This gear rank was defined as the product of the habitat rank and the gear distribution score. This relationship was chosen in order to ensure that the EFH vulnerability from gears not used in a particular habitat (*i.e.*, gear distribution = 0) would be 0, or, no effect.

EFH Vulnerability Ranking

Based on natural breaks in the frequency distribution of the gear rankings, the following vulnerability categories were defined:

0 = no vulnerability to the gear. This score could only be attained if the gear was not used in the habitat (gear distribution = 0).

1-6 = low vulnerability to the gear. This score generally occurred where the gear has minimal overlap with EFH (gear distribution = 1) and habitat rank was <7. Additionally, low vulnerability scores occurred in habitats with high gear overlap (gear distribution = 2) and habitat rank was 3.

7-9 = moderate vulnerability to the gear. This score typically occurred where gear overlap with EFH was high (gear distribution = 2) and habitat rank was 4, or, overlap with EFH was low (gear distribution = 1) and habitat rank was 7.

10-14 = high vulnerability to the gear. This score occurred only if the gear overlap with EFH was high (gear distribution = 2) and the habitat rank was 5.

Table 6.1. EFH vulnerability matrix analysis for benthic life stages of federally managed fish and invertebrate species in the Northeast U.S. Shelf Ecosystem

Species and Species Groups ^a	Habitat Criteria Scores						Gear Distribution Scores ^g						Gear Rank ^b						EFH Vulnerability Category ⁱ					
	Shelter ^b	Food ^c	Reproduction ^d	Habitat Sensitivity ^e	Habitat Rank ^f	Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	
American Plaice (A)	1	2	1	1	5	2	0	0	0	10	10	0	0	8	8	8	8	0	High	High	High	None	None	None
American Plaice (J)	1	2	0	1	4	2	2	2	0	10	10	0	0	8	8	8	8	0	Mod	Mod	Mod	Low	Low	Low
Atlantic Cod (A)	1	1	0	2	4	2	2	2	1	8	8	0	0	4	4	4	4	0	Mod	Mod	Mod	None	None	None
Atlantic Cod (J)	2	1	0	2	5	2	2	2	0	10	10	0	0	8	8	8	8	0	Mod	Mod	Mod	None	None	None
Atlantic Halibut (A)	1	1	1	4	2	2	2	2	0	8	8	0	0	8	8	8	8	0	Mod	Mod	Mod	None	None	None
Atlantic Halibut (J)	1	2	0	1	4	2	2	2	0	8	8	0	0	8	8	8	8	0	Mod	Mod	Mod	None	None	None
Atlantic Herring (E)	0	0	1	1	2	2	2	2	0	4	4	0	0	4	4	4	4	0	Low	Low	Low	None	None	None
Atlantic Herring (SA)	0	0	1	1	2	2	2	2	0	4	4	0	0	4	4	4	4	0	Low	Low	Low	None	None	None
Atlantic Surfclam (A)	1	0	1	1	3	2	2	2	2	6	6	0	0	6	6	6	6	0	Low	Low	Low	Low	Low	Low
Atlantic Surfclam (J)	1	0	0	1	2	2	2	2	2	4	4	0	0	4	4	4	4	0	Low	Low	Low	Low	Low	Low
Banddoor Skate (A)	1	1	1	1	4	2	2	2	1	8	8	0	0	4	4	4	4	0	Mod	Mod	Mod	Low	Low	Low
Banddoor Skate (J)	1	2	0	1	4	2	2	2	1	8	8	0	0	4	4	4	4	0	Mod	Mod	Mod	Low	Low	Low
Black Sea Bass (A)	2	1	0	2	5	2	2	2	2	10	10	0	0	10	10	10	10	0	High	High	High	High	High	High
Black Sea Bass (J)	2	1	0	2	5	2	2	2	2	10	10	0	0	10	10	10	10	0	High	High	High	High	High	High
Cleansole Skate (A)	1	1	1	1	4	2	2	2	2	8	8	0	0	8	8	8	8	0	Mod	Mod	Mod	Mod	Mod	Mod
Cleansole Skate (J)	1	2	0	1	4	2	2	2	2	8	8	0	0	8	8	8	8	0	Mod	Mod	Mod	Mod	Mod	Mod
Golden Deepsea Crab (J,A)	1	1	1	2	5	1	0	0	0	5	5	0	0	5	5	5	5	0	Low	Low	Low	None	None	None
Goosefish (A)	1	1	0	1	3	2	2	2	2	6	6	0	0	6	6	6	6	0	Low	Low	Low	Low	Low	Low
Goosefish (J)	1	0	1	1	3	2	2	2	2	6	6	0	0	6	6	6	6	0	Mod	Mod	Mod	Mod	Mod	Mod
Haddock (A)	1	2	0	2	5	2	2	2	1	10	10	0	0	5	5	5	5	0	High	High	High	Low	Low	Low
Haddock (J)	2	2	0	2	6	2	2	2	1	12	12	0	0	6	6	6	6	0	High	High	High	Low	Low	Low
Little Skate (A)	1	1	1	1	4	2	2	2	2	8	8	0	0	8	8	8	8	0	Mod	Mod	Mod	Mod	Mod	Mod
Little Skate (E)	0	0	1	1	2	2	2	2	2	4	4	0	0	4	4	4	4	0	Low	Low	Low	Low	Low	Low
Little Skate (J)	1	2	0	1	4	2	2	2	2	8	8	0	0	8	8	8	8	0	Mod	Mod	Mod	Mod	Mod	Mod
Ocean Pout (A)	2	2	1	2	7	2	2	2	2	14	14	0	0	14	14	14	14	0	High	High	High	High	High	High
Ocean Pout (E)	2	0	1	2	5	2	2	2	2	10	10	0	0	10	10	10	10	0	High	High	High	High	High	High
Ocean Pout (J)	2	2	0	2	6	2	2	2	2	12	12	0	0	12	12	12	12	0	High	High	High	High	High	High
Ocean Quahog (A)	1	0	1	1	3	2	2	2	2	6	6	0	0	6	6	6	6	0	Low	Low	Low	Low	Low	Low
Ocean Quahog (J)	1	0	0	1	2	2	2	2	2	4	4	0	0	4	4	4	4	0	Low	Low	Low	None	None	None
Offshore Hake (A)	1	1	0	1	3	2	1	0	0	6	6	0	0	3	3	3	3	0	Low	Low	Low	None	None	None
Offshore Hake (J)	1	1	0	1	3	2	1	0	0	6	6	0	0	3	3	3	3	0	Low	Low	Low	None	None	None
Pollock (A)	1	1	1	1	4	2	2	2	1	8	8	0	0	4	4	4	4	0	Mod	Mod	Mod	Low	Low	Low
Pollock (J)	1	1	0	1	3	2	2	2	1	6	6	0	0	3	3	3	3	0	Low	Low	Low	None	None	None
Red Deepsea Crab (A)	1	1	1	2	5	1	0	0	0	5	5	0	0	0	0	0	0	0	Low	Low	Low	None	None	None
Red Deepsea Crab (J)	1	1	0	2	4	1	0	0	0	4	4	0	0	0	0	0	0	0	Low	Low	Low	None	None	None
Red Drum (A)	1	1	0	1	3	2	2	2	2	6	6	0	0	6	6	6	6	0	Low	Low	Low	Low	Low	Low

Table 6.1. EFH vulnerability matrix analysis for benthic life stages of federally managed fish and invertebrate species in the Northeast U.S. Shelf Ecosystem

Species and Species Groups ^a	Habitat Criteria Scores				Gear Distribution Scores ^g				Gear Rank ^h				EFH Vulnerability Category ⁱ	
	Shelter ^b	Food ^c	Reproduction ^d	Habitat Sensitivity ^e	Habitat Rank ^f	Otter Trawl	Hydraulic Clam Dredge	Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Hydraulic Clam Dredge
Red Drum (J)	2	1	0	2	5	1	0	5	0	0	4	0	Low	None
Red Hake (A)	1	2	0	1	4	2	2	1	8	8	4	Mod	Mod	Low
Red Hake (J)	2	2	0	2	6	2	2	2	12	12	12	High	High	High
Redfish (A)	1	1	0	2	4	2	2	0	8	8	0	Mod	Mod	None
Redfish (J)	2	1	0	2	5	2	2	0	10	10	0	High	High	None
Rosette Skate (A)	1	1	1	1	4	2	2	2	8	8	8	Mod	Mod	Mod
Rosette Skate (J)	1	2	0	1	4	2	2	2	8	8	8	Mod	Mod	Mod
Skip (A)	1	0	1	3	2	2	2	2	6	6	6	Low	Low	Low
Skip (J)	1	2	0	1	4	2	2	2	8	8	8	Mod	Mod	Mod
Sea Scallops (A)	1	0	1	3	2	2	2	2	6	6	6	Low	Low	Low
Sea Scallops (J)	1	0	0	1	2	2	2	2	8	8	8	Mod	Mod	Mod
Silver Hake (A)	1	0	1	3	2	2	2	2	6	6	6	Low	Low	Low
Silver Hake (J)	1	1	0	2	4	2	2	2	8	8	8	Mod	Mod	Mod
Smooth Skate (A)	1	2	1	1	5	2	2	0	10	10	0	High	High	None
Smooth Skate (J)	1	2	0	1	4	2	2	0	8	8	0	Mod	Mod	None
Spiny Dogfish (A)	1	1	0	3	2	2	2	2	6	6	6	Low	Low	Low
Spiny Dogfish (J)	1	1	0	3	2	2	2	2	6	6	6	Low	Low	Low
Summer Flounder (A)	1	1	0	1	3	2	2	2	6	6	6	Low	Low	Low
Summer Flounder (J)	1	1	0	1	3	2	2	2	6	6	6	Low	Low	Low
Thorny Skate (A)	1	1	1	4	2	2	0	8	8	0	0	Mod	Mod	None
Thorny Skate (J)	1	2	0	1	4	2	2	0	8	8	0	Mod	Mod	None
Tilefish (A)	2	2	0	1	5	2	1	0	10	5	0	High	Low	None
Tilefish (J)	2	2	0	1	5	2	1	0	10	5	0	High	Low	None
White Hake (A)	1	1	0	3	2	2	0	6	6	0	0	Low	Low	None
White Hake (J)	1	2	0	1	4	2	2	0	8	8	0	Mod	Mod	None
Windowpane Flounder (A)	1	0	0	1	2	2	2	2	4	4	4	Low	Low	Low
Windowpane Flounder (J)	1	1	0	1	3	2	2	2	6	6	6	Low	Low	Low
Winter Flounder (A)	1	1	1	1	4	2	2	2	8	8	8	Mod	Mod	Mod
Winter Flounder (E)	0	1	1	1	2	2	2	2	4	4	4	Low	Low	Low
Winter Flounder (J)	1	1	0	1	3	2	2	2	6	6	6	Low	Low	Low
Winter Skate (J)	1	2	0	1	4	2	2	2	8	8	8	Mod	Mod	Mod
Winter Skate (A)	1	1	1	1	4	2	2	2	8	8	8	Mod	Mod	Mod
Witch Flounder (A)	1	2	0	1	4	2	1	1	8	4	4	Mod	Low	Low
Witch Flounder (J)	1	2	0	1	4	2	1	0	8	4	0	Mod	Low	None
Yellowtail Flounder (A)	1	2	0	1	4	2	2	2	8	8	8	Mod	Mod	Mod
Yellowtail Flounder (J)	1	2	0	1	4	2	2	2	8	8	8	Mod	Mod	Mod

Table 6.2. American plaice EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b				
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps	Sink Gill Nets and Bottom Longlines
Eggs	GOM, GB, and estuaries from Passamaquoddy Bay to Saco Bay, and from Massachusetts Bay to Cape Cod Bay	30-90	All year in GOM, December to June on GB; peaks in April and May for both areas	Surface waters	NA	NA	NA	NA	NA
Larvae	GOM, GB, SNE, and estuaries from Passamaquoddy Bay to Saco Bay, and from Massachusetts Bay to Cape Cod Bay	30-130	Between January and August, with peaks in April and May	Surface waters	NA	NA	NA	NA	NA
Juveniles	GOM and estuaries from Passamaquoddy Bay to Saco Bay, and from Massachusetts Bay to Cape Cod Bay	45-150		Bottom habitats with fine-grained sediments or a substrate of sand or gravel	M	M	0	L	L
Adults	GOM, GB, and estuaries from Passamaquoddy Bay to Saco Bay, and from Massachusetts Bay to Cape Cod Bay	45-175		Bottom habitats with fine-grained sediments or a substrate of sand or gravel	H	H	0	L	L
Spawning adults	GOM, GB, and estuaries from Passamaquoddy Bay to Saco Bay, and from Massachusetts Bay to Cape Cod Bay	<90	March through June	Bottom habitats of all substrate types	H	H	0	L	L

Rationale: American plaice (*Hippoglossoides platessoides*) juveniles, adults, and spawning adults are concentrated in the GOM, where they occupy a variety of habitat types with substrates of gravel or fine-grained sediments including sand. Plaice avoid rocky and hard-bottom areas and prefer fine, sticky but gritty sand mixtures and mud, as well as oozy mud in deep basins (Klein-MacPhee 2002d). Plaice have been caught a considerable distance off the bottom, and move off the bottom at night (Klein-MacPhee 2002d). They feed primarily on epibenthic invertebrates (mostly echinoderms and amphipods), so there is a potential that prey resources may be adversely affected by otter trawls and scallop dredges, particularly in areas of lower energy and expected slower habitat recovery. EFH vulnerability to these gears was rated as high for adults and moderate for juveniles primarily because spawning occurs on the bottom. Since hydraulic clam dredges do not typically operate in the GOM, vulnerability for this gear was rated as none.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.3. Atlantic cod EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GOM, GB, eastern portion of continental shelf off SNE, and following estuaries: Englishman/ Machias Bay to Blue Hill Bay, Sheepscot R., Casco Bay, Saco Bay, Great Bay, Massachusetts Bay, Boston Harbor, Cape Cod Bay, and Buzzards Bay	<110	Begins in fall, peaks in winter and spring	Surface waters	NA	NA	NA	NA
Larvae	GOM, GB, eastern portion of continental shelf off SNE and following estuaries: Passamaquoddy Bay to Penobscot Bay, Sheepscot R., Casco Bay, Saco Bay, Great Bay, Massachusetts Bay, Boston Harbor, Cape Cod Bay, and Buzzards Bay	30-70	Spring	Pelagic waters	NA	NA	NA	NA
Juveniles	GOM, GB, eastern portion of continental shelf off SNE and following estuaries: Passamaquoddy Bay to Saco Bay, Massachusetts Bay, Boston Harbor, Cape Cod Bay, and Buzzards Bay	25-75		Bottom habitats with a substrate of cobble or gravel	H	H	0	L
Adults	GOM, GB, SNE, middle Atlantic south to Delaware Bay and following estuaries: Passamaquoddy Bay to Saco Bay, Massachusetts Bay, Boston Harbor, Cape Cod Bay, and Buzzards Bay	10-150		Bottom habitats with a substrate of rocks, pebbles, or gravel	M	M	L	L
Spawning adults	GOM, GB, SNE, middle Atlantic south to Delaware Bay and following estuaries, Englishman/ Machias Bay to Blue Hill Bay, Sheepscot R., Massachusetts Bay, Boston Harbor, and Cape Cod Bay	10-150	Spawn during fall, winter, and early spring	Bottom habitats with a substrate of smooth sand, rocks, pebbles, or gravel	M	M	L	L

Rationale: Atlantic cod (*Gadus morhua*) are distributed regionally from Greenland to Cape Hatteras, from nearshore to depths >400 m. In U.S. waters, they are concentrated on GB and in the GOM, on rough bottom from 10-150 m (Fahay *et al.* 1999; Klein-MacPhee 2002a). Eggs and larvae are pelagic, so EFH vulnerability is not applicable. Juvenile cod are found mostly in nearshore shoal waters or on offshore banks. Cobble is preferred over finer grained sediments, and this life stage appears to use benthic structure and cryptic coloration to escape predation (Fahay *et al.* 1999). Juvenile cod may benefit, perhaps strongly, from physical and biological complexity (Lindholm *et al.* (2001); see discussion in Chapter 2 of this document). Otter trawls and scallop dredges have been shown to reduce habitat complexity (see Chapter 5), therefore EFH vulnerability to these gear types was rated as high since the gear may affect the functional value of EFH for this life stage. Vulnerability to clam dredges was rated as none since this gear is not operated in juvenile cod EFH (see Chapter 4). Adults and spawning adults occupy a variety of hard-bottom habitat types, including rock, pebbles, and gravel, and tend to avoid finer sediments. Cod eat a wide variety of prey, including fish, decapod crustaceans, amphipods, and polychaetes (Fahay *et al.* 1999). Although adult cod are primarily found on rough bottom, the scientific literature does not indicate that this habitat type serves the same function as it does for juvenile cod. Based on the variable diet and lack of evidence for direct functional value of benthic habitat, EFH vulnerability to otter trawl and scallop dredges was rated as moderate. Adult cod may use areas where clam dredges operate, such as the nearshore waters of New Jersey, on a seasonal basis. Clam dredges operate only in sand (NREFHSC 2002), and the recovery of benthic communities from the effects of clam dredging in nearshore, sandy habitats is rapid (Table 5.15). Clam beds are not chronically disturbed by dredging since the population of clams, which are benthic infauna, must recover before fishing is again profitable (NREFHSC 2002). Based on this information and the rationale described for otter trawls and scallop dredges, habitat vulnerability for hydraulic clam dredges was rated as low. EFH vulnerability for adults applies to spawning adults as well.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.4. Atlantic halibut EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b		
					New Bedford-Style Scallop Dredge	Otter Trawl	Hydraulic Clam Dredge
Eggs	GOM, GB		Between late fall and early spring, peaks in November and December	Pelagic waters to the seafloor	0	0	0
Larvae	GOM, GB			Surface waters	NA	NA	NA
Juveniles	GOM, GB	20-60		Bottom habitats with a substrate of sand, gravel, or clay	M	M	0
Adults	GOM, GB	100-700		Bottom habitats with a substrate of sand, gravel, or clay	M	M	0
Spawning adults	GOM, GB	<700	Between late fall and early spring, peaks in November and December	Bottom habitats with a substrate of soft mud, clay, sand, or gravel; rough or rocky bottom locations along slopes of the outer banks	M	M	0

Rationale: Atlantic halibut (*Hippoglossus hippoglossus*) are found in the temperate, boreal and subarctic Atlantic, south to New Jersey, and were once common from Nantucket Shoals to Labrador (Klein-MacPhee 2002d). They have been found at depths from 25-1000 m, but 700-900 m is probably the deepest they are found in any numbers. Atlantic halibut eggs are bathypelagic and are fertilized on the bottom (Cargnelli, Griesbach, and Morse 1999; Klein-MacPhee 2002d). Since eggs occur close to, but not on the bottom, scallop dredges, otter trawls, and hydraulic clam dredges are not expected to affect the functional value of the habitat for this life stage, and EFH vulnerability was rated as none. Juvenile, adult and spawning adult halibut occupy a variety of habitat types north of Nantucket Shoals. Adults are not found on soft mud or on rock bottom (Cargnelli, Griesbach, and Morse 1999). Spawning is occasionally associated with complex habitats. Juvenile halibut feed mostly on annelid worms and crustaceans, then transition to a diet of mostly fish as adults (Klein-MacPhee 2002d). EFH vulnerability to scallop dredges and otter trawls was rated as moderate for juveniles and adults. EFH vulnerability for clam dredges was rated as none since this gear type does not operate in halibut EFH (see Chapter 4 of this document).

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.5. Atlantic herring EFH – vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GOM, GB, SNE and following estuaries: Englishman/Machias Bay, Casco Bay, and Cape Cod Bay	20-80	July through November	Bottom habitats with a substrate of gravel, sand, cobble, shell fragments, and aquatic macrophytes, tidal currents 1.5-3 knots	L	L	0	L
Larvae	GOM, GB, SNE and following estuaries: Passamaquoddy Bay to Cape Cod Bay, Narragansett Bay, and Hudson R/Raritan Bay	50-90	Between August and April, peaks from September to November	Pelagic waters	NA	NA	NA	NA
Juveniles	GOM, GB, SNE and Middle Atlantic south to Cape Hatteras and following estuaries: Passamaquoddy Bay to Cape Cod Bay, Buzzards Bay to Long Island Sound, Gardiners Bay to Delaware Bay	15-135		Pelagic waters and bottom habitats	NA	NA	NA	NA
Adults	GOM, GB, SNE and middle Atlantic south to Cape Hatteras and following estuaries: Passamaquoddy Bay to Great Bay, Massachusetts Bay to Cape Cod Bay, Buzzards Bay to Long Island Sound, Gardiners Bay to Delaware Bay, and Chesapeake Bay	20-130		Pelagic waters and bottom habitats	NA	NA	NA	NA
Spawning adults	GOM, GB, SNE and middle Atlantic south to Delaware Bay and Englishman/Machias Bay Estuary	20-80	July through November	Bottom habitats with a substrate of gravel, sand, cobble, and shell fragments, also on aquatic macrophytes	L	L	0	L

Rationale: Atlantic herring (*Clupea harengus*) is a coastal pelagic species ranging from Labrador to Cape Hatteras in the western Atlantic (Reid *et al.* 1999; Munroe 2002). For pelagic life stages (larvae, juveniles, adults) EFH vulnerability to bottom-tending fishing gears is not applicable. Atlantic herring eggs are laid in high-energy, benthic habitats on gravel, sand, or rocky substrates, and on macrophytes (Reid *et al.* 1999; Munroe 2002). These habitats are less susceptible to fishing gear impacts since they have evolved under a high-energy disturbance regime (strong bottom currents). Vulnerability of herring egg EFH to scallop dredges and otter trawls is considered low. Although these gears may directly affect the eggs, only the effect of the gear on the functional value of the habitat was considered for this evaluation. EFH vulnerability from clam dredges was considered to be none since this gear does not operate in areas of herring egg EFH. Spawning adults are closely associated with the bottom. Effects on the functional value of habitat from mobile gears are unknown, and were rated as low since spawning occurs on the bottom. EFH vulnerability from clam dredges was rated as none for the reasons described above. Spawning could be disrupted by noise associated with these gears, but this issue was not addressed as a habitat-related issue.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank, and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; H = high vulnerability.

Table 6.6. Atlantic mackerel EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b		
					New Bedford-Style Scallop Dredge	Otter Trawl	Hydraulic Clam Dredge
Eggs	Continental shelf from Maine through Cape Hatteras, also includes the following estuaries: Great Bay to Cape Cod Bay, Buzzards Bay to Long Island Sound, Gardiners Bay, and Great South Bay	0-15	Pelagic waters	NA	NA	NA	NA
Larvae	Continental shelf from Maine through Cape Hatteras, also includes the following estuaries: Great Bay to Cape Cod Bay, Buzzards Bay to Long Island Sound, Gardiners Bay, and Great South Bay	10-130	Pelagic waters	NA	NA	NA	NA
Juveniles	Continental shelf from GOM through Cape Hatteras, also includes the following estuaries: Passamaquoddy Bay, Penobscot Bay to Saco Bay, Great Bay, Massachusetts Bay to Cape Cod Bay, Narragansett Bay, Long Island Sound, Gardiners Bay to Hudson R / Raritan Bay	0-320	Pelagic waters	NA	NA	NA	NA
Adults	Continental shelf from GOM through Cape Hatteras, also includes the following estuaries: Passamaquoddy Bay to Saco Bay, Massachusetts Bay to Long Island Sound, Gardiners Bay to Hudson R / Raritan Bay	0-380	Pelagic waters	NA	NA	NA	NA

Rationale: All life stages of Atlantic mackerel (*Scomber scombrus*) are pelagic, so their EFH is not vulnerable to bottom-tending fishing gear, and vulnerability was categorized as "not applicable."

^a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

^b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.7. Atlantic salmon EFH-vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs		30-31	Between October and April	Bottom habitats with a gravel or cobble riffle (redd) above or below a pool in rivers	NA	NA	NA	NA
Larvae	The following rivers from Connecticut to Maine: Connecticut, Pawcatuck, Merrimack, Cocheo, Saco, Androscoggin, Presumpscot, Kennebec, Sheepscot, Ducktrap, Union, Penobscot, Narraguagus, Machias, East Machias, Pleasant, St. Croix, Denny's, Passagassawakeag, Aroostook, Lamprey, Boyden, and Orland rivers, and Turk, Hobart and Patten Streams, and the following estuaries and embayments for juveniles and adults: Passamaquoddy Bay to Muscongus Bay, Casco Bay to Wells Harbor, Massachusetts Bay, Long Island Sound, and Gardiners Bay to Great South Bay. EFH includes all aquatic habitats in the watersheds of the above listed rivers, including all tributaries to the extent that they are currently or were historically accessible for salmon migration.	10-61	Between March and June for alewives/fry	Bottom habitats with a gravel or cobble riffle (redd) above or below a pool in rivers	NA	NA	NA	NA
Juveniles				Bottom habitats of shallow gravel/cobble riffles interspersed with deeper riffles and pools in rivers and estuaries, water velocities of 30-92 cm/s	NA	NA	NA	NA
Adults				Oceanic adult Atlantic salmon are primarily pelagic and range from waters of the continental shelf off SNE north throughout the GOM, dissolved oxygen >5 ppm for migratory pathway	NA	NA	NA	NA
Spawning adults		30-61	October and November	Bottom habitats with a gravel or cobble riffle (redd) above or below a pool in rivers	NA	NA	NA	NA

Rationale: Atlantic salmon (*Salmo salar*) eggs and larvae are found in riverine areas where the fishing gears under consideration are not used, so EFH vulnerability is not applicable. It is important to note that these life stages are particularly vulnerable to non-fishing-related impacts such as point-source discharges and polluted runoff. Juveniles and adults are pelagic in nature, and vulnerability of EFH to bottom-tending fishing gear is not applicable for these life stages.

^a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

^b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.8. Atlantic surfclam EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Juveniles	Eastern edge of GB and the GOM throughout Atlantic EEZ	0-60, low density beyond 38		Throughout substrate to a depth of 3 ft within federal waters, burrow in medium to coarse sand and gravel substrates, also found in silty to fine sand, but not in mud	L	L	L	L
Adults	Eastern edge of GB and the GOM throughout Atlantic EEZ	0-60, low density beyond 38	Spawn summer to fall	Throughout substrate to a depth of 3 ft within federal waters	L	L	L	L

Rationale: Atlantic surfclams (*Spisula solidissima*) are found in sandy continental shelf habitats from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina (Cargnelli *et al.* 1999a). They burrow into substrates from fine to coarse sandy gravel, and are not found in mud. Although clam dredges remove clams from the sediment, the habitat's functional value is probably not affected. Juvenile and adult EFH vulnerability was therefore rated as low for all mobile gears. Surfclam eggs and larvae are pelagic, therefore EFH vulnerability is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.9. Barndoor skate EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Juveniles	Eastern GOM, GB, SNE, Mid-Atlantic Bight to Hudson Canyon	0-750, mostly <150		Bottom habitats with mud, gravel, and sand substrates	M	M	L	L
Adults	Eastern GOM, GB, SNE, Mid-Atlantic Bight to Hudson Canyon	0-750, mostly <150		Bottom habitats with mud, gravel, and sand substrates	M	M	L	L

Rationale: Barndoor skate (*Dipturus laevis*) occur from Newfoundland south to Cape Hatteras, but are most abundant on GB and in the GOM. They are found on soft mud, sand, and gravel (Packer *et al.* 2003a). Barndoor skate feed on invertebrates usually associated with the bottom, including polychaetes, gastropods, and bivalves, as well as squid and fish. Smaller individuals feed primarily on polychaetes, copepods, and amphipods, while larger individuals capture larger and more active prey (McEachran 2002, Packer *et al.* 2003a). A single fertilized egg is encapsulated in a leathery capsule known as a "mermaid's purse." The young hatch in late spring or early summer, and are thought to be about 18-19 cm in length, although very little information is available on this life stage (Packer *et al.* 2003a). Juvenile EFH was considered to be moderately vulnerable to otter trawls and scallop dredges because of the closer association of juveniles to a benthic invertebrate diet. Adult EFH vulnerability to otter trawls and scallop dredges was rated as moderate due primarily to their reproductive habits. EFH vulnerability to clam dredges was rated as low for juveniles and adults because this gear is not extensively used in EFH.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.10 Black sea bass EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					New Bedford-Style Scallop Dredge	Otter Trawl	Hydraulic Clam Dredge	Pots and Traps
Eggs	Continental shelf and estuaries from SNE to North Carolina; also includes Buzzards Bay	0-200	May to October	Water column of coastal Mid-Atlantic Bight and Buzzards Bay	NA	NA	NA	NA
Larvae	Pelagic waters over continental shelf from GOM to Cape Hatteras; also includes Buzzards Bay	<100	May to November, peak June to July	Habitats for transforming (to juveniles) larvae are near coastal areas and into marine parts of estuaries between Virginia and NY; when larvae become demersal, found on structured inshore habitat such as sponge beds	NA	NA	NA	NA
Juveniles	Demersal waters over continental shelf from GOM to Cape Hatteras, also includes the following estuaries: Buzzards Bay to Long Island Sound, Gardiners Bay, Barnegat Bay to Chesapeake Bay, Tangier/Pocomoke Sound, and James R	1-38	Found in coastal areas (April to December, peak June to November) between Virginia and Massachusetts, but winter offshore from New Jersey south; in estuaries in summer and spring	Rough bottom, shellfish and eelgrass beds, man-made structures in sandy-shelly areas, offshore clam beds, and shell patches may be used during wintering	NA	NA	NA	NA
Adults	Demersal waters over continental shelf from GOM to Cape Hatteras, also includes the following estuaries: Buzzards Bay, Narragansett Bay, Gardiners Bay, Great South Bay, Barnegat Bay to Chesapeake Bay, Tangier/Pocomoke Sound, and James R	20-50	Wintering adults (November to April) offshore, south of New York to North Carolina; inshore, in estuaries from May to October	Structured habitats (natural and man-made), sand and shell substrates preferred	NA	NA	NA	NA

Rationale: Black sea bass (*Centropristes striata*) are found in coastal waters of the northwest Atlantic, from Cape Cod south to Cape Canaveral (Klein-MacPhee 2002e). Occasionally they stray as far north as the Bay of Fundy (GOM). Juveniles are common in high-salinity estuaries. Adults and juveniles are found in estuaries from Massachusetts south to the James River, Virginia (Stone *et al.* 1994). Black sea bass larvae are pelagic, but then become demersal and occupy structured inshore habitat such as sponge beds, eelgrass beds, shellfish beds, shell patches, and other rough bottoms (Steimle, Zetlin, Berrien, and Chang 1999) and offshore shell patches including clam beds (Able and Fahay 1998). The availability of structure limits successful post-larval and/or juvenile recruitment (Steimle, Zetlin, Berrien, and Chang 1999). Juveniles are diurnal visual predators that feed on benthic invertebrates and small fish. Adults are also structure oriented, and are thought to use structure as shelter during the day, but may stray off it to hunt at night. Each of these life stages is associated with structure that may be vulnerable to fishing gear impacts, so vulnerability was rated as high for all mobile gears. It is important to note that structured habitats comprised of wrecks or other artificial reefs prone to damage by mobile gear may be avoided by fishermen. This is true of high-relief natural areas as well. Black sea bass eggs are pelagic, so vulnerability to EFH is not applicable. Although larvae are pelagic, they do become demersal as they transition into juveniles. Therefore, larvae were rated the same as juveniles.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.11. Bluefish EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					New Bedford-Style Scallop Dredge	Otter Trawl	Hydraulic Clam Dredge	Pots and Traps
Eggs	North of Cape Hatteras--over continental shelf from Montauk Point south to Cape Hatteras; south of Cape Hatteras--over continental shelf through Key West, Florida	Mid-shelf depths	April to August	Pelagic waters	NA	NA	NA	NA
Larvae	North of Cape Hatteras--over continental shelf from Montauk Point south to Cape Hatteras; south of Cape Hatteras--over continental shelf through Key West, the slope sea, and Gulf Stream between latitudes 29°N and 40°N; includes Narragansett Bay	> 15	April to September	Pelagic waters	NA	NA	NA	NA
Juveniles	North of Cape Hatteras--over continental shelf from Nantucket Island south to Cape Hatteras; south of Cape Hatteras--over continental shelf through Key West, the slope sea, and Gulf Stream between latitudes 29°N and 40°N; also includes the following estuaries: Penobscot Bay to Great Bay, Massachusetts Bay to James R., Albemarle Sound to St. Johns R.		North Atlantic estuaries from June to October; mid-Atlantic estuaries from May to October; South Atlantic estuaries from March to December	Pelagic waters	NA	NA	NA	NA
Adults	North of Cape Hatteras--over continental shelf from Cape Cod Bay south to Cape Hatteras; south of Cape Hatteras--found over continental shelf through Key West; also includes the following estuaries: Penobscot Bay to Great Bay, Massachusetts Bay to James R., Albemarle Sound to Pamlico/Pungo R., Bougue Sound, Cape Fear R., St. Helena Sound, Broad R., St. Johns R., and Indian R.		North Atlantic estuaries from June to October; mid-Atlantic estuaries from April to October; South Atlantic estuaries from May to January	Pelagic waters	NA	NA	NA	NA

Rationale: All life stages of bluefish (*Pomatomus saltatrix*) are pelagic, so their EFH is not vulnerable to bottom-tending fishing gears, and vulnerability is not applicable.

^a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

^b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.12. Butterfish EFH-vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	Over continental shelf from GOM through Cape Hatteras; also estuaries, including Massachusetts Bay to Long Island Sound, Gardiners Bay, Great South Bay, and Chesapeake Bay	0-1829	Spring and summer	Pelagic waters	NA	NA	NA	Sink Gill Nets and Bottom Longlines
Larvae	Over continental shelf from GOM through Cape Hatteras; also estuaries, including Boston Harbor, Waquoit Bay to Long Island Sound, Gardiners Bay to Hudson R./Raritan Bay, Delaware Bay, and Chesapeake Bay	10-1829	Summer and fall	Pelagic waters	NA	NA	NA	NA
Juveniles	Over continental shelf from GOM through Cape Hatteras; also estuaries, including Massachusetts Bay, Cape Cod Bay to Delaware inland bays, Chesapeake Bay, York R., and James R.	10-365 (most <120)	Winter-shelf; spring to fall-estuaries	Pelagic waters (larger individuals found over sandy and muddy substrates)	NA	NA	NA	NA
Adults	Over continental shelf from GOM through Cape Hatteras; also estuaries, including Massachusetts Bay, Cape Cod Bay to Hudson R./Raritan Bay, Delaware Bay and inland bays, York R., and James R.	10-365 (most <120)	Winter-shelf; summer to fall-estuaries	Pelagic waters (schools form over sandy, sandy silt, and muddy substrates)	NA	NA	NA	NA

Rationale: All life stages of butterfish (*Peprilus triacanthus*) are pelagic, so their EFH is not vulnerable to bottom-tending fishing gear, and vulnerability is not applicable.

^a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

^b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.13. Clearnose skate EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Juveniles	GOM, along shelf to Cape Hatteras ; includes the estuaries from Hudson River/Raritan Bay south to the Chesapeake Bay mainstem	0 – 500, mostly < 111		Bottom habitats with substrate of soft bottom along continental shelf, and rocky or gravelly bottom	M	M	M	L
Adults	GOM, along shelf to Cape Hatteras ; includes the estuaries from Hudson River/Raritan Bay south to the Chesapeake Bay mainstem	0 – 500, mostly < 111		Bottom habitats with substrate of soft bottom along continental shelf, and rocky or gravelly bottom	M	M	M	L

Rationale: Clearnose skate (*Raja eglanteria*) occur in the GOM, but are most abundant from Cape Hatteras north to Delaware Bay. They are found over soft bottoms of mud and sand, as well as on rocky or gravelly bottoms. They have been captured from shore out to depths of 330 m, but are most abundant at depths less than 111 m (Packer *et al.* 2003b). Adults and juveniles feed on polychaetes, amphipods, decapod crustaceans, mollusks, and fish. Like barndoor skates, crabs and benthic invertebrates are more important for smaller, younger individuals, and the importance of fish in the diet increases with age (McEachran 2002; Packer *et al.* 2003b). A single fertilized egg is encapsulated in a leathery case. Eggs are deposited in the spring or summer, and hatch 3 mo later. Juvenile EFH was considered moderately vulnerable to otter trawls, scallop dredges, and clam dredges because of the close association of juveniles to a benthic invertebrate diet. Adult EFH vulnerability to otter trawls, scallop dredges, and clam dredges was rated as moderate due primarily to the species' reproductive habits.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.14. Cobia EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
All life stages	South Atlantic and Mid-Atlantic Bights			Sandy shoals of capes and offshore bars; high-profile rock bottoms and barrier island oceanside waters from surf zone to shelf break, but from the Gulf Stream shoreward; also high salinity bays, estuaries, seagrass habitat	NA	NA	NA	NA

Rationale: All life stages of cobia (*Rachycentron canadum*) are pelagic, so their EFH is not vulnerable to bottom tending fishing gear, and vulnerability is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.15. Golden deepsea crab EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
All life stages	Chesapeake Bay to the south through the Florida Straight (and into the Gulf of Mexico)	290-570		Continental slope in flat areas of foraminifera ooze, on distinct mounds of dead coral, ripple habitat, dunes, black pebble habitat, low outcrop, and soft bioturbated habitat	L	0	0	L

Rationale: The golden deepsea crab (*Chaceon fenneri*) inhabits the continental slope of Bermuda and the southeastern United States from Chesapeake Bay south through the Florida Straight and into the Gulf of Mexico (SAFMC 1998). Although similar to the red deepsea crab, less is known about this species. They are categorized as opportunistic scavengers, and are found in depths from 290-570 m on substrates of foraminiferal ooze, dead coral mounds, deep rippled habitat, dunes, and black pebble habitat. Scallop dredges and clam dredges do not operate in golden crab EFH due to depth, so EFH vulnerability was rated as none. Most otter trawling operates in depths less than 200 m so EFH vulnerability was rated as low for this gear type.

^a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

^b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1). NA = not applicable, 0 = no vulnerability, L = low vulnerability, M = moderate vulnerability, and H = high vulnerability.

Table 6.16. Goosefish EFH-vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GOM, GB, SNE, middle Atlantic south to Cape Hatteras	15-1000	March to September	Surface waters	NA	NA	NA	NA
Larvae	GOM, GB, SNE, middle Atlantic south to Cape Hatteras	25-1000	March to September	Pelagic waters	NA	NA	NA	NA
Juveniles	Outer continental shelf in the middle Atlantic, mid-shelf off SNE, all areas of GOM	25-200		Bottom habitats with substrates of a sand-shell mix, algae-covered rocks, hard sand, pebbly gravel, or mud	L	L	L	L
Adults	Outer continental shelf in the middle Atlantic, mid-shelf off SNE, outer perimeter of GB, all areas of GOM	25-200		Bottom habitats with substrates of a sand-shell mix, algae-covered rocks, hard sand, pebbly gravel, or mud	L	L	L	L
Spawning adults	Outer continental shelf in the middle Atlantic, mid-shelf off SNE, outer perimeter of GB, all areas of GOM	25-200	February to August	Bottom habitats with substrates of a sand-shell mix, algae-covered rocks, hard sand, pebbly gravel, or mud	L	L	L	L

Rationale: Goosefish (*Lophius americanus*), are demersal anglerfish found from Newfoundland south to Florida, but are common only north of Cape Hatteras (Steimle, Morse, and Johnson 1999). Juveniles are primarily found at depths between 40 and 75 m, while adults are concentrated between 50-100 m. In the GOM, adults occur primarily between the depths of 130-260 m. Occasionally, adults are seen at the surface. Both juveniles and adults (including spawning adults) occur on substrates ranging from mud to gravelly sand, algae, and rocks. A goosefish has been observed digging depressions in the bottom substrate with its pectoral fins until its back was almost flush with the surrounding bottom (Caruso 2002). The goosefish is a sight predator that uses its highly modified first dorsal fin as an angling apparatus to lure small fishes towards its mouth (Caruso 2002). Goosefish eat a wide array of prey items, but mainly fish and cephalopods. Goosefish have been reported to ingest a variety of seabirds. There are no indications in the literature that any goosefish life stage is habitat limited or that the functional value of its habitat could be adversely affected by fishing. Vulnerability of adult and juvenile EFH to mobile fishing gear was rated as low. Goosefish eggs and larvae are pelagic, and vulnerability to bottom-tending fishing gear is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; L = no vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.17. Haddock EFH-vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b		
					Otter Trawl	New Bedford-Style Scallop Dredge	Sink Gill Nets and Bottom Longlines
Eggs	GB southwest to Nantucket Shoals, coastal areas of GOM, and the following estuaries: Great Bay, Massachusetts Bay, Boston Harbor, Cape Cod Bay, Buzzards Bay	50-90	March to May, peaks in April	Surface waters	NA	NA	NA
Larvae	GB southwest to Delaware Bay, and the following estuaries: Great Bay, Massachusetts Bay, Boston Harbor, Cape Cod Bay, Buzzards Bay, and Narragansett Bay	30-90	January to July, peaks in April and May	Surface waters	NA	NA	NA
Juveniles	GB, GOM, and middle Atlantic south to Delaware Bay	35-100		Bottom habitats with a substrate of pebble and gravel	H	H	L
Adults	GOM, GB, Nantucket Shoals, and the Great South Channel	40-150		Bottom habitats with a substrate of broken ground, pebbles, smooth hard sand, and smooth areas between rocky patches	H	H	L
Spawning adults	GOM, GB, Nantucket Shoals, and the Great South Channel	40-150	January to June	Bottom habitats with a substrate of pebble, gravel, or gravelly sand	H	H	L

Rationale: Haddock (*Melanogrammus aeglefinus*) are found from Greenland to Cape Hatteras and are common throughout the GOM, Georges Bank, and SNE (Cargnelli, Griesbach, Berrien, *et al.* 1999; Klein-MacPhee 2002a). Juveniles older than 3 m and adults are demersal and generally found in waters from 10-150 m in depth. Juveniles are usually found in waters shallower than 100 m. Haddock spawn over pebble and gravel substrate, and avoid ledges, rocks, kelp, and soft mud (Cargnelli, Griesbach, Berrien, *et al.* 1999). Haddock eggs and larvae are pelagic, and EFH vulnerability to fishing gear is not applicable. Juvenile haddock, like juvenile cod, may benefit, perhaps strongly, from physical and biological complexity (see discussion in Chapter 2). In general, haddock have a stronger benthic affinity than cod (Klein-MacPhee 2002a). Juvenile haddock are chiefly found over pebble and gravel substrates (Cargnelli, Griesbach, Berrien, *et al.* 1999). Once demersal, they feed on benthic fauna, and their primary prey items are crustaceans and polychaetes. The habitat complexity that appears to be important to juvenile haddock can be reduced by otter trawls and scallop dredges, and benthic prey may be affected (see Chapter 5). Juvenile haddock EFH are considered highly vulnerable to these two gear types. Vulnerability to clam dredges was rated as low since there is some use of this gear in juvenile EFH. Adult haddock are found on broken ground, gravel, pebbles, clay, smooth sand, and sticky sand of gritty consistency, with a preference for smooth areas around rock patches (Klein-MacPhee 2002a). They feed indiscriminately on benthic invertebrates, and occasionally on fish. Adults (including spawning adults) occupy a variety of habitat types that might be affected by otter trawls and scallop dredges. Adults may be less closely linked to complex habitats than juveniles, but there is still some association. Haddock are expected to be more strongly linked to benthic habitats than cod, since haddock primarily feed on benthic invertebrates, while cod are primarily piscivorous. Benthic prey resources for haddock may be adversely affected by scallop dredges or otter trawls in areas of lower energy and expected slower habitat recovery. Overall, adult EFH vulnerability to these gear types was rated as high. Clam dredges operate only in sand, and the associated recovery period is short (Table 5.15). Moreover, clam dredging is not expected to create a chronic disturbance in these areas since the population of clams, which are benthic infauna, must recover before fishing is again profitable; therefore, habitat vulnerability for clam dredges was rated as low.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.18. King mackerel EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description		EFH Vulnerability ^b		
				Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps	Sink Gill Nets and Bottom Longlines
All life stages	South Atlantic and Mid-Atlantic Bights		Sandy shoals of capes and offshore bars; high-profile rock bottoms and barrier island oceanside waters from surf zone to shelf break, but from the Gulf Stream shoreward, also high salinity bays, estuaries, seagrass habitat	NA	NA	NA	NA	NA

Rationale: All life stages of king mackerel (*Scomberomorus cavalla*) are pelagic, so their EFH is not vulnerable to bottom-tending fishing gear, and vulnerability is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.19. Little skate EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description		EFH Vulnerability ^b		
				Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps	Sink Gill Nets and Bottom Longlines
Eggs	GB to Cape Hatteras; includes the estuaries from Buzzards Bay south to the Chesapeake Bay mainstem	<27		Bottom habitats with sandy substrate	L	L	L	L
Juveniles	GB to Cape Hatteras; includes the estuaries from Buzzards Bay south to the Chesapeake Bay mainstem	0-137, mostly 73-91		Bottom habitats with sandy or gravelly substrate or mud	M	M	M	L
Adults	GB to Cape Hatteras; includes the estuaries from Buzzards Bay south to the Chesapeake Bay mainstem	0-137, mostly 73-91		Bottom habitats with sandy or gravelly substrate or mud	M	M	M	L

Rationale: Little skate (*Leucoraja erinacea*) range from Nova Scotia to Cape Hatteras, and are most abundant on GB and in coastal waters south to the mouth of Chesapeake Bay. They have been found at depths up to 500 m, but are most common at depths less than 111 m (Packer *et al.* 2003c). In SNE, juveniles and adults have been associated with microhabitat features including biogenic depressions and flat sand during the day (Auster *et al.* 1991, 1995). They are generally found on sandy or gravelly bottoms, but also occur on mud. They co-occur with winter skates, and are more active at night, although they appear to feed throughout the day and night. The most important prey are amphipods and decapod crustaceans, followed by polychaetes (Packer *et al.* 2003c). Prey items of minor importance include bivalves, isopods, and fish. Similar to batrachoid and clearnose skates, the use of fish as a food source increases with increasing size. Smaller skates eat more amphipods, and larger skate consume more decapod crustaceans (Packer *et al.* 2003c). A single fertilized egg is encapsulated in a leathery case that is deposited on sandy substrate. The cases have sticky filaments that adhere to bottom substrates. In one study, eggs deposited in the late spring and early summer required 5 to 6 mo to hatch. Other studies have shown incubation to exceed 1 yr. When the young hatch, they are considered juveniles and are fully developed assuring from 93-102 mm in total length (Packer *et al.* 2003c). Vulnerability of juvenile EFH to mobile bottom gear was characterized as moderate because of the species dependence on benthic organisms in its diet. Vulnerability of adult EFH to mobile bottom gear was characterized as moderate due to its reproductive habits. Little skate is the only skate species in which EFH has been designed for eggs. Although bottom-tending mobile gears may have adverse effects upon the eggs themselves, this was not considered to be a habitat impact. Since the bottom substrate appears to provide an attachment point for the eggs, the EFH vulnerability to mobile gear was rated as low instead of none.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.20. Longfin inshore squid EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps	Sink Gill Nets and Bottom Longlines
Juveniles	Over continental shelf from GOM through Cape Hatteras	0-213	Inshore spring to fall; offshore in winter	Pelagic waters	NA	NA	NA	NA
Adults	Over continental shelf from GOM through Cape Hatteras	0-305	Inshore March to October; offshore in winter	Pelagic waters	NA	NA	NA	NA

Rationale: Longfin inshore squid (*Loligo pealeii*) is a pelagic schooling species. It is distributed in continental shelf and slope waters from Newfoundland to the Gulf of Venezuela (Cargnelli, Griesbach, McBride, *et al.* 1999). Most life stages of longfin inshore squid are pelagic; however, encapsulated eggs are laid in masses, called “mops,” that are attached to structures such as rocks and algae on substrates of sand, mud, or on hard-bottom in depths <50m (Cargnelli, Griesbach, McBride, 1999). As of this writing, EFH has not been designated for longfin inshore squid eggs.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.21. Northern shortfin squid EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b				
					New Bedford-Style Scallop Dredge	Otter Trawl	Hydraulic Clam Dredge	Pots and Traps	Sink Gill Nets and Bottom Longlines
Juveniles	Over continental shelf from GOM through Cape Hatteras	0-182	Carried northward by Gulf Stream	Pelagic waters	NA	NA	NA	NA	NA
Adults	Over continental shelf from GOM through Cape Hatteras	0-182	Offshore late fall; spawn December to March	Pelagic waters	NA	NA	NA	NA	NA

Rationale: All stages of northern shortfin squid (*Illlex illecebrosus*) are pelagic, so their EFH is not vulnerable to bottom tending fishing gear, and vulnerability is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.22. Ocean pout EFH-vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GOM, GB, SNE, middle Atlantic south to Delaware Bay, and the following estuaries: Passamaquoddy Bay to Saco Bay, Massachusetts Bay, and Cape Cod Bay	<50	Late fall and winter	Bottom habitats, generally hard-bottom sheltered nests, holes, or crevices where they are guarded by parents	H	H	H	L
Larvae	GOM, GB, SNE, middle Atlantic south to Delaware Bay, and the following estuaries: Passamaquoddy Bay to Saco Bay, Massachusetts Bay, and Cape Cod Bay	<50	Late fall to spring	Bottom habitats in close proximity to hard-bottom nesting areas	H	H	H	L
Juveniles	GOM, GB, SNE, middle Atlantic south to Delaware Bay, and the following estuaries: Passamaquoddy Bay to Saco Bay, Massachusetts Bay, Boston Harbor, and Cape Cod Bay	<80		Bottom habitats, often smooth bottom near rocks or algae	H	H	H	L
Adults	GOM, GB, SNE, middle Atlantic south to Delaware Bay, and the following estuaries: Passamaquoddy Bay to Saco Bay, Massachusetts Bay, Boston Harbor, and Cape Cod Bay	<110		Bottom habitats; dig depressions in soft sediments which are then used by other species	H	H	H	L
Spawning adults	GOM, GB, SNE, middle Atlantic south to Delaware Bay, and the following estuaries: Passamaquoddy Bay to Saco Bay, Massachusetts Bay, and Cape Cod Bay	<50	Late summer to early winter, peaks in September and October	Bottom habitats with a hard-bottom substrate, including artificial reefs and shipwrecks	H	H	H	L

Rationale: Ocean pout (*Zoarces americanus*) is a demersal species found in the western Atlantic from Labrador south to Cape Hatteras (Steimle, Morse, Berrien, Johnson, and Zetlin 1999). It can occur in deeper waters south of Cape Hatteras, and has been found as deep as 363 m (Klein-MacPhee and Collette 2002a). It is found in most estuaries and embayments in the GOM, and is caught by the NEFSC trawl surveys in greatest abundance off SNE (Steimle, Morse, Berrien, Johnson, and Zetlin 1999). Ocean pout eggs are laid in nests in crevices, on hard-bottom, or in holes and protected by the female parent for 2.5-3 mo until they hatch (Klein-MacPhee and Collette 2002a). Potential impacts to habitat from otter trawls, scallop dredges, and clam dredges include knocking down boulder piles, removing biogenic structure, and filling in bottom depressions, which may disturb nests and/or leave these areas less suitable for nests. In addition, fishing may frighten parents from nests leaving eggs susceptible to predation. Egg EFH is therefore considered to have a high vulnerability to all bottom-tending mobile gears. Ocean pout have a relatively short larval stage, and some authors (Klein-MacPhee and Collette 2002a) suggest that there is no larval stage (Steimle, Morse, Berrien, Johnson, and Zetlin 1999). Since the NEFMC designated EFH for this life stage, it is considered here. Larvae (hatchlings) remain near the nest site; however, there is little information on their use of habitats. Larvae do not appear to be as closely associated with the bottom as eggs or juveniles; however, it is anticipated that loss of structure may impact larvae to some degree. Larval EFH was determined to have high vulnerability to mobile bottom-tending gears. Juvenile pout are found under rocks, shells and algae, in coastal waters and are closely associated with the bottom (Steimle, Morse, Berrien, Johnson, and Zetlin 1999). They feed on benthic invertebrates such as gammarid amphipods and polychaetes. It is expected that loss of structure may significantly impact juvenile EFH. Vulnerability of juvenile EFH to all mobile gears was considered high. Adult pout are found in sand and gravel in winter and spring, and in rocky/hard substrate areas for spawning and nesting (Klein-MacPhee and Collette 2002a). They create burrows in soft sediments, and their diet consists mainly of benthic invertebrates including mollusks, crustaceans, and echinoderms. Because of the strong benthic affinity of ocean pout, it is anticipated that vulnerability of adult EFH to all mobile gears is high.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank, and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1); NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; H = high vulnerability.

Table 6.23. Ocean quahog EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Juveniles	Eastern edge of GB and GOM throughout the EEZ	8-245		Throughout substrate to a depth of 3 ft within federal waters; occurs progressively farther offshore between Cape Cod and Cape Hatteras	L	L	L	L
Adults	Eastern edge of GB and GOM throughout the EEZ	8-245	Spawn May to December with several peaks	Throughout substrate to a depth of 3 ft within federal waters; occurs progressively farther offshore between Cape Cod and Cape Hatteras	L	L	L	L

Rationale: Ocean quahog (*Arcidea islandica*) juveniles are found in offshore sandy substrate, and may survive in muddy intertidal areas (Cargnelli *et al.* 1999b). Adults are found in similar offshore habitats, just below the surface of the sediment, usually in medium- to fine-grained sand. Although clam dredges remove clams from the sediment, the habitat's functional value is probably not affected. Juvenile and adult EFH vulnerability was therefore rated as low for all mobile gears. Ocean quahog eggs and larvae are pelagic, therefore EFH vulnerability is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.24. Offshore hake EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b		
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge
Eggs	Outer continental shelf of GB and SNE south to Cape Hatteras	<1250	Observed all year and primarily collected at depths from 110-270 m	Pelagic waters	NA	NA	NA
Larvae	Outer continental shelf of GB and SNE south to Chesapeake Bay	<1250	Observed all year and primarily collected at depths from 70-130m	Pelagic waters	NA	NA	NA
Juveniles	Outer continental shelf of GB and SNE south to Cape Hatteras	170-350		Bottom habitats	L	L	0
Adults	Outer continental shelf of GB and SNE south to Cape Hatteras	150-380		Bottom habitats	L	L	0
Spawning adults	Outer continental shelf of GB and SNE south to the Middle Atlantic Bight	330-550	Spawn throughout the year	Bottom habitats	L	L	0

Rationale: Offshore hake (*Merluccius albidus*) are distributed over the continental shelf and slope of the Northwest Atlantic, ranging from the Grand Banks south to the Caribbean and Gulf of Mexico (Chang, Berrien, Johnson, and Zetlin 1999; Klein-MacPhee 2002f). Juveniles and adults are found in deeper waters, and are most abundant at depths between 150-380 m. They are an important component in the slope community off Florida, and are reportedly caught near the outer edge of the Scotian Shelf, and on the slopes of deep basins in the GOM and the continental slope from the southeastern edge of GB south. Because of their depth preference, very little is known about the offshore component of the stock. Moreover, offshore hake are similar in appearance to silver hake, and may have been misidentified in earlier studies. They are taken commercially as bycatch in the silver hake fishery. No information is available on substrate preferences for juveniles and adults. Eggs and larvae are pelagic, and EFH vulnerability to fishing gears is not applicable. Juvenile and adult offshore hake appear to feed at or near the bottom, and are primarily piscivorous (feeding particularly on clupeids, anchovies, and lanternfishes), but they also eat crustaceans and squid (Klein-MacPhee 2002). There is evidence of adult diel vertical migration. Only limited information exists about this species, and none of it indicates that offshore hake have a very strong bottom affinity, or that impacts from fishing gear would affect the functional value of their habitat. Although spawning occurs near the bottom, the actual use of benthic habitat during spawning is unknown. The vulnerability of adult and juvenile EFH to otter trawls and scallop dredges is expected to be low. Vulnerability to clam dredges was rated as none since the gear does not operate in the EFH of this species.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.25. Pollock EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GOM, GB, and the following estuaries: Great Bay to Boston Harbor	30–270	October to June, peaks November to February	Pelagic waters	NA	NA	NA	NA
Larvae	GOM, GB, and the following estuaries: Passamaquoddy Bay, Sheepscot R., and Great Bay to Cape Cod Bay	10–250	September to July, peaks December to February	Pelagic waters	NA	NA	NA	NA
Juveniles	GOM, GB, and the following estuaries: Passamaquoddy Bay to Saco Bay, Great Bay to Waquoit Bay, Long Island Sound, and Great South Bay	0–250		Bottom habitats with aquatic vegetation or a substrate of sand, mud, or rocks	L	L	L	L
Adults	GOM, GB, SNE, and middle Atlantic south to New Jersey, and the following estuaries: Passamaquoddy Bay, Damariscotta R., Massachusetts Bay, Cape Cod Bay, and Long Island Sound	15–365		Hard-bottom habitats, including artificial reefs	M	M	L	L
Spawning adults	GOM, SNE, and middle Atlantic south to New Jersey, including Massachusetts Bay	15–365	September to April, peaks December to February	Bottom habitats with a substrate of hard, stony, or rocky bottom; includes artificial reefs	M	M	L	L

Rationale: Pollock (*Pollachius virens*) range from the Hudson straits to North Carolina (Klein-MacPhee 2002a), and are most common on the Scotian Shelf, Georges Bank, the Great South Channel, and GOM (Cargnelli, Griesbach, Packer, Berrien, Johnson, *et al.* 1999). They segregate into schools by size, and avoid water warmer than about 15°C (Klein-MacPhee 2002a). They are active fish that live at any depth between the bottom and the surface, depending upon food supply. They are associated with coastal areas and offshore shoals, and are found from shore out to depths of about 325 m, but are most common from 75–175 m (Cargnelli, Griesbach, Packer, Berrien, Johnson, *et al.* 1999). Juveniles frequently occupy the rocky intertidal zone, which may serve as a nursery area (Klein-MacPhee 2002a). Neither adults nor juveniles are selective in substrate type. Pollock are opportunistic, and the diet of both juveniles and adults consists mainly of euphausiid crustaceans, but fish, other crustaceans and squid, are also eaten (Cargnelli, Griesbach, Packer, Berrien, Johnson, *et al.* 1999; Klein-MacPhee 2002a). Adults spawn over broken bottom and the slopes of offshore banks, and eggs are pelagic. Based on food habits, and the distribution and behavior of pollock, vulnerability of juvenile EFH to benthic mobile gear was characterized as low. Since pollock spawn on the bottom, the vulnerability of adult EFH to otter trawls and scallop dredges was rated as moderate. EFH vulnerability from clam dredges was rated as low for juveniles and adults since there is limited use of this gear in pollock EFH. Pollock eggs and larvae are pelagic, so EFH vulnerability to fishing gear is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.26. Red deepsea crab EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b		
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge
Eggs	Southern flank of GB and south to Cape Hatteras	200-400		Attached to the underside of the female crab until hatched--see spawning adults	NA	NA	NA
Larvae	Southern flank of GB and south to Cape Hatteras	200-1800	January to June	Water column from surface to seafloor	NA	NA	NA
Juveniles	Southern flank of GB and south to Cape Hatteras	700-1800		Bottom habitats of continental slope with a substrate of silts, clays, and all silt-clay-sand composites	L	0	0
Adults	Southern flank of GB and south to Cape Hatteras	200-1300		Bottom habitats of continental slope with a substrate of silts, clays, and all silt-clay-sand composites	L	0	0
Spawning adults	Southern flank of GB and south to Cape Hatteras	200-1300		Bottom habitats of continental slope with a substrate of silts, clays, and all silt-clay-sand composites	L	0	0

Rationale: Red deepsea crab (*Chaceon (Geryon) quinqueiens*) are found on the outer continental shelf and slope of the western Atlantic from Nova Scotia into the Gulf of Mexico (Steimle *et al.* 2001). They are found on the bottom, chiefly in water depths of 200-1800 m, and for adults is from 700-1800 m. They are found on substrates ranging from silt and clay to hard substrates. Red crab are opportunistic benthic feeders/scavengers, with a diet of epifauna and other opportunistically available items (Steimle *et al.* 2001). Post-larval juveniles feed on a wide variety of infaunal and epifaunal benthic invertebrates. Small crabs eat sponges, hydroids, gastropods, and other organisms. Larger crabs eat similar small benthic fauna and larger prey including demersal and midwater fishes. The only fishery using mobile bottom gear that operates in red crab EFH is the goosefish trawl fishery (NEFMC 2002). The vulnerability of adult and juvenile red crab EFH to otter trawls was characterized as low because of their opportunistic feeding habits. Vulnerability to scallop dredges and clam dredges was rated as none since those gears do not operate in red crab EFH. Larval red crabs are pelagic and EFH vulnerability is not applicable. The “habitat” for eggs is the female carapace, therefore EFH vulnerability for this life stage is also not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.27. Red drum EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Larvae	Along the Atlantic coast from Virginia through the Florida Keys	<50		Estuarine wetlands are especially important flooded saltmarshes, brackish marsh, tidal creeks, mangrove fringe, seagrasses)	NA	NA	NA	NA
Juveniles	Along the Atlantic coast from Virginia through the Florida Keys	<50	Found throughout Chesapeake Bay from September to November	Utilize shallow backwaters of estuaries as nursery areas and remain until they move to deeper water portions of the estuary associated with river mouths, oyster bars, and front beaches	L	0	0	L
Adults	Along the Atlantic coast from Virginia through the Florida Keys	<50	Found in Chesapeake in spring and fall, and also along eastern shore of VA	Concentrate around inlets, shoals, and capes along the Atlantic coast; shallow bay bottoms or oyster reef substrate preferred, also nearshore artificial reefs	L	L	L	L

Rationale: Red drum (*Sciaenops ocellatus*) are distributed in estuarine and coastal waters depending upon their stage of maturity (McGurkin 1994). Juvenile red drum are found in shallow estuarine backwaters, and as they grow, they move to deeper areas. Submerged aquatic vegetation (SAV) is particularly important habitat for juvenile drum. Subadult and adult red drum are found on estuarine bay bottoms or oyster reefs, and in nearshore coastal waters including the beach zone out to several miles from shore. Juvenile and adult red drum have a varied diet. Smaller juveniles eat copepods and mysids, while larger individuals eat decapod crustaceans (crabs and shrimp), fish, and plant material (McGurkin 1994). Although SAV is an important habitat for juvenile red drum, EFH vulnerability to otter trawls was rated as low since its use in SAV is limited. Scallop dredges and hydraulic clam dredges usually are not used in juvenile red drum EFH; therefore, EFH vulnerability for these gears was rated as none. Since red drum feed on a variety of organisms, and adults are found in many habitat types, vulnerability of adult EFH to mobile bottom gear was rated as low. Red drum eggs and larvae are pelagic; therefore, EFH vulnerability is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.28. Red hake EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b				
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps	Sink Gill Nets and Bottom Longlines
Eggs	GOM, GB, continental shelf off SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Sheepscot R., Great Bay to Cape Cod Bay, Buzzards Bay, and Narragansett Bay		May to November, peaks in June and July	Surface waters of inner continental shelf	NA	NA	NA	NA	NA
Larvae	GOM, GB, continental shelf off SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Sheepscot R., Massachusetts Bay to Cape Cod Bay; Buzzards Bay, Narragansett Bay and Hudson R./ Raritan Bay	<200	May to December, peaks in September and October	Surface waters	NA	NA	NA	NA	NA
Juveniles	GOM, GB, continental shelf off SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Passamaquoddy Bay to Saco Bay; Great Bay, Massachusetts Bay to Cape Cod Bay, Buzzards Bay to Connecticut R., Hudson R./ Raritan Bay, and Chesapeake Bay	<100		Bottom habitats with substrate of shell fragments, including areas with an abundance of live sea scallops	H	H	H	L	L
Adults	GOM, GB, continental shelf off SNE, and middle Atlantic south to Cape Hatteras and the following estuaries: Passamaquoddy Bay to Saco Bay, Great Bay, Massachusetts Bay to Cape Cod Bay, Buzzards Bay to Connecticut R., Hudson R./ Raritan Bay, Delaware Bay, and Chesapeake Bay	10-130		Bottom habitats in depressions with a substrate of sand and mud	M	M	L	L	L
Spawning adults	GOM, southern edge of GB, continental shelf off SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Sheepscot R., Massachusetts Bay, Cape Cod Bay, Buzzards Bay, and Narragansett Bay	<100	May to November, peaks in June and July	Bottom habitats in depressions with a substrate of sand and mud	M	M	L	L	L

Rationale: Red hake (*Urophycis chuss*) is a demersal species that ranges from southern Newfoundland to North Carolina, and is most abundant between GB and New Jersey (Steimle, Morse, Berrien, and Johnson 1999). They occur at depths between 35-980 m, and are most common between 72-124 m (Klein-MacPhee 2002a). Larvae, juveniles, and adults have been found in estuaries from Maine south to Chesapeake Bay (NEFMC 1998). Eggs and larvae are pelagic, and EFH vulnerability to bottom-tending fishing gear is not applicable. Juvenile red hake are found in live sea scallops or empty scallop shells, and are associated with other objects such as other shells, sponges, and rocks (Klein-MacPhee 2002a). Sheller appears to be a critical habitat requirement for this life stage (Able and Fahay 1998), and physical complexity, including biogenic structure other than scallop shells, may be important (Auster *et al.* 1991, 1995). Their diet consists mainly of amphipods and other infauna and epifauna. Juvenile red hake EFH is considered highly vulnerable to all three mobile gear groups. Adult red hake feed mainly on euphausiids, and consume other invertebrates and fish (Klein-MacPhee 2002a). They are found mainly on soft bottoms (sand and mud) where they create depressions or use existing depressions. They are also found on shell beds, but not on open, sandy bottom. Otter trawls and scallop dredges operate in these soft bottom and shell bed areas and have been shown to affect the structural components of these habitats. Offshore in Maryland and northern Virginia, adult red hake are found on temperate reefs and hard-bottom areas. There is a potential that otter trawls could operate in hard-bottom areas and adversely affect the functional value of these reef habitats. Vulnerability of red hake EFH to otter trawls and scallop dredges was assessed as moderate. Clam dredges would not typically operate in these hard-bottom areas, or in the softer sediments with which red hake are usually associated in the northern extent of their range, but there is some overlap between adult EFH and clam dredge use in sandy habitats. EFH vulnerability to clam dredges was characterized as low.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; H = high vulnerability.

Table 6.29. Redfish EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	Viviparous (eggs are retained in mother, released as larvae)				NA	NA	NA	NA
Larvae	GOM and southern GB	50-270	March to October, peak in August	Pelagic waters	NA	NA	NA	NA
Juveniles	GOM and southern edge of GB	25-400		Bottom habitats with a substrate of silt, mud, or hard-bottom	H	H	0	L
Adults	GOM and southern edge of GB	50-350		Bottom habitats with a substrate of silt, mud, or hard-bottom	M	M	0	L
Spawning adults	GOM and southern edge of GB	5-350	April to August	Bottom habitats with a substrate of silt, mud, or hard-bottom	M	M	0	L

Rationale: There are four species of redfish in the Northeast Region. They are *Sebastodes fasciatus* (Acadian redfish), *S. mentella* (deepwater redfish), *S. norvegicus* (golden redfish), and *Helicolenus dactylopterus* (blackbelly rosefish). These four species are difficult to discriminate at all life stages, hence they are usually combined (Pikanowski *et al.* 1999). Acadian redfish range from Iceland to New Jersey, and deepwater redfish occur from the GOM north. Where the species overlap, the deepwater redfish occurs in deeper water. They range in depth from 25-592 m (Klein-MacPhee and Collette 2002b), with adults most common from 125-200 m, and juveniles from 75 to 175 m (Pikanowski *et al.* 1999). In general, information about redfish is very limited. Females bear live young and larvae are pelagic, so habitat vulnerability is not applicable to eggs or larvae. Redfish are found chiefly on silt, mud, or hard-bottom and rarely over sand (Pikanowski *et al.* 1999). On the Scotian Shelf, they are strongly associated with a fine-grained, silt-clay bottom (Klein-MacPhee and Collette 2002b), as well as with deposits of gravel and boulders (Pikanowski *et al.* 1999). It is hypothesized that redfish do not prefer a particular bottom type, but may be more exposed to predation over a featureless bottom due to their sedentary nature. There is limited evidence that juveniles use anemones and boulders for cover (Pikanowski *et al.* 1999). Early demersal-phase Acadian redfish have been observed to occur primarily in piled boulder habitats, while late-juvenile redfish occur in both piled boulder, gravel, and dense cerianthid anemone habitats (Auster, Lindholm, and Valentine 2003). Acadian redfish have also been observed in association with deepwater corals and sponges in the GOM (Auster 2005). Habitat vulnerability from otter trawls and scallop dredges in boulder habitats is high since gear can overturn boulders and reduce the number of crevices, as well as dislodge cerianthid anemones from the bottom. Redfish are benthic during the day, and become more active at night when they rise off the bottom, following the vertical migration of their primary euphausiid prey (Pikanowski *et al.* 1999). They also eat some benthic fish. Adult EFH was determined to be moderately vulnerable to impacts from otter trawls and scallop dredges. Clam dredges do not operate in areas of redfish EFH, so vulnerability was rated as none.

^a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

^b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.30. Rosette skate EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Juveniles	Nantucket Shoals and southern edge of GB to Cape Hatteras	33-530, mostly 74-274		Bottom habitats with soft substrate, including sand/mud bottoms, mud with echinoid and ophiuroid fragments, and shell and pteropod ooze	M	M	M	M
Adults	Nantucket Shoals and southern edge of GB to Cape Hatteras	33-530, mostly 74-274		Bottom habitats with soft substrate, including sand/mud bottoms, mud with echinoid and ophiuroid fragments, and shell and pteropod ooze	M	M	M	M

Rationale: Rosette skate (*Leucoraja garnotii virginica*) is a deeper water species that occurs along the outer shelf and continental slope from Nantucket Shoals to the Dry Tortugas, Florida. North of Cape Hatteras, it is most abundant in the southern section of the Chesapeake Bay. It occurs on soft bottoms, including sand and mud, at depths from 33-530 m, and is most common between 74-274 m (Packer *et al.* 2003d). Major prey items include polychaetes, copepods, cumaceans, amphipods, crabs, squid, octopods, and small fishes. A single fertilized egg is encapsulated in a leathery case. Egg cases are found in mature females most frequently in the summer (Packer *et al.* 2003d). Information on rosette skate is very limited. Because of the limited information available, the apparent dependence of the juveniles of this species on benthic organisms in its diet, and the reproductive habits of the adults, EFH vulnerability to mobile bottom gear was characterized as moderate.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.31. Scup EFH-vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	SNE to coastal Virginia, including the following estuaries: Waquoit Bay to Long Island Sound, Gardiners Bay, and Hudson R./Raritan Bay	(<30)	May to August	Pelagic waters in estuaries	NA	NA	NA	NA
Larvae	SNE to coastal Virginia, including the following estuaries: Waquoit Bay to Long Island Sound, Gardiners Bay, and Hudson R./Raritan Bay	(<20)	May to September	Pelagic waters in estuaries	NA	NA	NA	NA
Juveniles	Continental shelf from GOM to Cape Hatteras, including the following estuaries: Massachusetts Bay, Cape Cod Bay to Long Island Sound, Gardiners Bay to Delaware inland bays, and Chesapeake Bay	(0-38)	Spring and summer in estuaries and bays	Demersal waters north of Cape Hatteras; inshore on various sand, mud, mussel, and eelgrass bed substrates	M	M	M	L
Adults	Continental shelf from GOM to Cape Hatteras, including the following estuaries: Cape Cod Bay to Long Island Sound, Gardiners Bay to Hudson R./Raritan Bay, Delaware Bay, Delaware inland bays, and Chesapeake Bay	(2-185)	Wintering adults (November to April) are usually offshore, south of New York to North Carolina	Demersal waters north of Cape Hatteras; inshore estuaries on various substrate types	L	L	L	L

Rationale: Scup (*Stenotomus chrysops*) is a temperate species that occurs primarily from Massachusetts to South Carolina, although it has been reported as far north as the Bay of Fundy and Sable Island Bank (Steinle, Zetlin, Berrien, Johnson, and Chang 1999a). Scup are primarily benthic feeders that use a variety of habitat types. Juveniles forage on epibenthic amphipods, other small crustaceans, polychaetes, mollusks, and fish eggs and larvae. They occur over a variety of substrates, and are most abundant in areas without structure. Limited observations of scup have shown periodic use of seafloor depressions for cover (Auster *et al.* 1991, 1995). Adults are found on soft bottoms or near structures. During the summer, they are closer inshore and are found on a wider range of habitats. In the winter, they congregate offshore in areas that are expected to serve as a thermal refuge (Klein-McPhee 2002), particularly in deeper waters of the outer continental shelf and around canyon heads. Smaller adults feed on echinoderms, amphelids, and small crustaceans. Larger scup consume more squids and fishes. Since juvenile scup are primarily benthic feeders, their EFH was rated as moderately vulnerable to impacts from mobile bottom gear. EFH vulnerability for adults was rated as low since there is less of a reliance on benthic prey items.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.32 Sea scallop EFH -- vulnerability to effects of bottom-tending fishing and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GOM, GB, SNE, middle Atlantic south to Virginia-North Carolina border, and the following estuaries: Passamaquoddy Bay to Sheepscot R., Casco Bay, Massachusetts Bay, and Cape Cod Bay	May through October, peaks in May and June in middle Atlantic area, and in Sept. and Oct. on GB and in GOM	Bottom habitats	L	L	L	L	L
Larvae	GOM, GB, SNE, middle Atlantic south to Virginia-North Carolina border, and the following estuaries: Passamaquoddy Bay to Sheepscot R., Casco Bay, Massachusetts Bay, and Cape Cod Bay	18-110	Pelagic waters	NA	NA	NA	NA	NA
Juveniles	GOM, GB, SNE, middle Atlantic south to Virginia-North Carolina border, and the following estuaries: Passamaquoddy Bay to Sheepscot R., Casco Bay, Great Bay, Massachusetts Bay, and Cape Cod Bay	18-110	Bottom habitats with a substrate of gravelly sand, shell fragments, pebbles, or on various red algae, hydroids, amphipod tubes, and bryozoans	L	L	L	L	L
Adults	GOM, GB, SNE, middle Atlantic south to Virginia-North Carolina border, and the following estuaries: Passamaquoddy Bay to Sheepscot R., Casco Bay, Great Bay, Massachusetts Bay, and Cape Cod Bay	18-110	Bottom habitats with a substrate of cobble, shells, and silt	L	L	L	L	L
Spawning adults	GOM, GB, SNE middle Atlantic south to Virginia-North Carolina border, and the following estuaries: Passamaquoddy Bay to Sheepscot R., Casco Bay, Massachusetts Bay, and Cape Cod Bay	May through October, peaks in May and June in middle Atlantic area, and in Sept. and Oct. on GB and in GOM	Bottom habitats with a substrate of cobble, shells, coarse/gravelly sand, and sand	L	L	L	L	L

Rationale: Juvenile and adult sea scallops (*Placopecten magellanicus*) are found on the continental shelf of the Northwest Atlantic, from the Gulf of St. Lawrence south to Cape Hatteras, typically between 18 and 110 m, but also as shallow as 2 m in estuaries and embayments along the Maine coast, and as deep as 384 m (Packer, Cargnelli, *et al.* 1999). In the GOM, populations have been reported at depths of 170-180 m. Scallops are rarely found at depths <55 m in “southern areas.” Scallop eggs are slightly heavier than seawater and are thought to remain on the bottom during development, but bottom habitats have no known functional value for eggs, and therefore, their vulnerability to fishing was rated as low for all gear types. There are four pelagic larval stages, and EFH vulnerability to fishing gear impacts for these larval stages is not applicable. However, the last larval stage is benthic; at this stage, larvae settle to the bottom (as “spat”) and attach to hard surfaces (Packer, Cargnelli, *et al.* 1999). Settlement occurs in areas of gravelly sand with shell fragments. Spat are very delicate and do not survive on shifting sand bottoms. The availability of suitable surfaces on which to settle appears to be a primary requirement for successful reproduction (Packer, Cargnelli, *et al.* 1999). There is a close association between the bryozoan *Eucratia loricata* and spat. *Eucratia* attach to adult scallops, and have been found to contain large numbers of spat. EFH for benthic-phase larvae was given a low rating for vulnerability to all three mobile gear types because any disturbance of the bottom they would cause would most likely redistribute bottom sediments suitable for settlement (gravel, pebbles, shell fragments), but not reduce their availability. Juveniles are found mainly on gravel, small rocks, shells, and silt. During their second growing season (5-12 mm), sea scallops become mobile and leave the original substrate on which they settled, and then re-

Table 6.32 Sea scallop EFH -- vulnerability to effects of bottom-tending fishing and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b				
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps	Sink Gill Nets and Bottom Longlines
attach to shells and bottom debris. Otter trawls, scallop dredges, and hydraulic clam dredges are used in bottom habitats occupied by juvenile scallops, but the disturbance of the seafloor caused by these gears does not adversely affect the functional value of the habitat and, therefore, the vulnerability of juvenile scallop EFH to mobile benthic gears was rated as low. The same conclusion was reached for fixed gear which cause negligible disturbance to the seafloor. Juveniles and adults are found in benthic habitats with at least some water movement, which is critical for feeding, oxygen and removal of waste; optimal growth for adults occurs at 10 cm/sec (Packer, Cagnelli, <i>et al.</i> 1999). Adult scallops inhabit coarse substrates, usually gravel, shell, and rock. Because fine clay particles interfere with feeding activity, scallops are not usually found on muddy bottom. No scientific information exists that indicates mobile fishing gears have a negative impact on the functional value of adult scallop EFH. The vulnerability of adult scallop EFH to mobile benthic gears was therefore rated as low.									

^a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.^b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.33. Silver hake EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GOM, GB, continental shelf off SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Merrimack R to Cape Cod Bay	50–150	All year, peaks June to October	Surface waters	NA	NA	NA	NA
Larvae	GOM, GB, continental shelf off SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Massachusetts Bay to Cape Cod Bay	50–130	All year, peaks July to September	Surface waters	NA	NA	NA	NA
Juveniles	GOM, GB, continental shelf off SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Passamaquoddy Bay to Casco Bay, and Massachusetts Bay to Cape Cod Bay	20–270		Bottom habitats of all substrate types	M	M	M	L
Adults	GOM, GB, continental shelf off SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Passamaquoddy Bay to Casco Bay, and Massachusetts Bay to Cape Cod Bay	30–325		Bottom habitats of all substrate types	L	L	L	L
Spawning adults	GOM, GB, continental shelf off SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Massachusetts Bay and Cape Cod Bay	30–325		Bottom habitats of all substrate types	L	L	L	L

Rationale: Silver hake or whiting (*Merluccius bilinearis*) range from Newfoundland south to Cape Fear, NC, and are most common from Nova Scotia to New Jersey (Morse *et al.* 1999). They are distributed broadly, and are found from nearshore shallows out to a depth of 400 m (Klein-MacPhee 2002). All life stages have been found in estuaries from Maine to Cape Cod Bay (Morse *et al.* 1999). The vertical movement of silver hake is governed chiefly by their pursuit of prey, both juveniles and adults show a vertical migration off the bottom at night when feeding activity is greatest. In the Mid-Atlantic Bight, juvenile silver hake have been found in greater densities in areas with greater amphipod tube cover (Auster *et al.* 1997). Further, silver hake size distributions in sand wave habitats are positively correlated with sand wave period (*i.e.*, the spacing between sand waves), suggesting energetic or prey capture benefits in particular sand wave environments (Auster, Lindholm, Schaub, *et al.* 2003). Juveniles are primarily found on silt or sand substrate, and feed mainly on crustaceans, including copepods, amphipods, euphausiids, and decapod crustaceans (Morse *et al.* 1999). The vulnerability of juvenile EFH to mobile gear was rated as moderate because of the potential connection between structure and habitat suitability for this life stage. Adult silver hake rest on the bottom in depressions by day, primarily over sand and pebble bottoms, and rarely in rockier areas. In the Mid-Atlantic Bight, adults were found on flat sand, sand wave crests, shell, and biogenic depressions, but were most often found on flat sand. At night, adults feed on anchovies, herring, lanternfish, and other fishes (Klein-MacPhee 2002). Piscivory increases with size for this species. Vulnerability of adult silver hake EFH to the three mobile gear types was rated as low because of silver hake's piscivorous food habits and preference for higher energy sand environments which recover quickly from fishing gear impacts (see Chapter 5 of this document). Eggs and larvae of this species are pelagic, so habitat vulnerability to fishing gear is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.34. Smooth skate EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Juveniles	Offshore banks of GOM	31–874, mostly 110–457		Bottom habitats with a substrate of soft mud (silt and clay), sand, broken shells, gravel, and pebbles	M	M	0	L
Adults	Offshore banks of GOM	31–874, mostly 110–457		Bottom habitats with a substrate of soft mud (silt and clay), sand, broken shells, gravel, and pebbles	H	H	0	L

Rationale: Smooth skate's (*Malacoraja senta*) center of abundance is the GOM. It occurs along the Atlantic coast from the Gulf of St. Lawrence south to South Carolina, at depths between 31–874 m (Packer *et al.* 2003e). It is most abundant between 110–457 m. Analysis of NEFSC trawl survey data found juvenile skate most abundant between depths of 100 –300 m during 1963–1969. Smooth skate are found mostly over soft mud and clay of the GOM's deepwater basins, but also over the gulf's offshore banks with substrates of sand, shell, and/or gravel (Packer *et al.* 2003e). The diet of smooth skate is generally limited to epifaunal crustaceans, with decapod shrimp and euphausiids as the most common prey, followed by amphipods and mysids. The diet shifts from amphipods and mysids to decapod crustaceans as smooth skate grow (Packer *et al.* 2003e). The diet of smooth skate is more restricted than that of other skate species (McEachran 2002). The vulnerability of juvenile smooth skate EFH to otter trawls and scallop dredges was characterized as moderate because of the dietary habits of this species. The vulnerability of adult EFH was rated as high for otter trawls and scallop dredges because of the benthic diet as well as the reproductive habits of the species. Vulnerability to clam dredges was considered to be none for juveniles and adults since this gear is not used in the GOM.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.35 Spanish mackerel EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
All life stages	South Atlantic and Mid-Atlantic Bights			Sandy shoals of capes and offshore bars; high-profile rock bottoms and barrier island oceanside waters from surf zone to shelf break, but from the Gulf Stream shoreward	NA	NA	NA	NA

Rationale: All life stages of Spanish mackerel (*Scomberomorus maculatus*) are pelagic, so their EFH is not vulnerable to bottom-tending fishing gear, and vulnerability is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.36. Spiny dogfish EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Juveniles	Across the continental shelf from GOM to Cape Hatteras, and south of Cape Hatteras through Florida; also includes the following estuaries: Passamaquoddy Bay to Saco Bay; Massachusetts Bay, and Cape Cod Bay	10-390	Continental shelf waters and estuaries	L	L	L	L	L
Adults	Across the continental shelf from GOM to Cape Hatteras, and south of Cape Hatteras through Florida; also includes following estuaries: Passamaquoddy Bay to Saco Bay, Massachusetts Bay, and Cape Cod Bay	10-450	Continental shelf waters and estuaries	L	L	L	L	L

Rationale: The spiny dogfish (*Squalus acanthias*) is a coastal shark with a circum boreal distribution, and is one of the most abundant sharks in the western North Atlantic (McMillan and Morse 1999). Female dogfish are viviparous, so EFH designations were limited to juveniles and adults. Smaller dogfish have been reported to feed primarily on crustaceans, with an increase in piscivory in larger individuals (Burgess 2002). Fish, mainly schooling pelagic species, constitute 50% of their diet. Their voracious and opportunistic feeding behavior was emphasized by McMillan and Morse (1999). Since neither of these life stages appears to be closely tied to benthic organisms, the vulnerability of their EFH to mobile gear was rated as low.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank, and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.37. Summer flounder EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b				
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps	Sink Gill Nets and Bottom Longlines
Eggs	Over continental shelf from GOM to Florida	30-70 in fall; 110 in winter; 9-30 in spring	October to May	Pelagic waters; heaviest concentrations within 9 mi of shore off New Jersey and New York	NA	NA	NA	NA	NA
Larvae	Over continental shelf from GOM to Florida; also includes the following estuaries: Waquoit Bay to Narragansett Bay, Hudson R/Raritan Bay, Barnegat Bay, Chesapeake Bay, Rappahannock R., York R., James R., Albemarle Sound, Pamlico Sound, and Neuse R. to Indian R.	10-70	Mid-Atlantic Bight from September to February; southern part of range from November to May at depths of 9-30 m	Pelagic waters; larvae most abundant 19-83 km from shore	NA	NA	NA	NA	NA
Juveniles	Over continental shelf from GOM to Florida; also includes the following estuaries: Waquoit Bay to James R., and Albemarle Sound to Indian R.	0.5-5 in estuary		Demersal waters, on muddy substrate but prefer mostly sand; found in the lower estuaries in flats, channels, salt marsh creeks, and eelgrass beds	HAPC	H	0	0	NA
Adults	Over continental shelf from GOM to Florida; also includes the following estuaries: Buzzards Bay, Narragansett Bay, Connecticut R. to James R., Albemarle Sound to Broad R.; St. Johns R., and Indian R.	0-25	Shallow coastal and estuarine waters during warmer months; move offshore on outer continental shelf at depths of 150 m in colder months	Demersal waters and estuaries	Non-HAPC	L	L	0	0

Rationale: Summer flounder (*Paralichthys dentatus*) occur in the shallow estuarine waters and outer continental shelf from Nova Scotia to Florida, with the center of their range located in the Mid-Atlantic Bight (Packer, Griesbach, *et al.* 1999). Juvenile summer flounder are opportunistic feeders, and their diet includes fish, mysids, and some other crustaceans (Packer, Griesbach, *et al.* 1999). There are gradual changes in the diet of summer flounder, with fish becoming more important as a food source as individuals get older and larger. Adults are also opportunistic feeders, with fish and crustaceans making up a significant portion of their diet. Eelgrass and macroalgae beds have been designated as habitat areas of particular concern (HAPC) for adult and juvenile summer flounder. Stephan *et al.* (2000) determined that otter trawls could result in below-ground impacts to submerged aquatic vegetation (SAV), which, of all the impacts to SAV possible from fishing gear, was ranked as the impact of greatest concern. Based on potential impacts to SAV, the vulnerability of the summer flounder HAPC to otter trawls was rated as high. Sea scallop and surfclam/quahog dredges are not used in estuaries where SAV is found. Fixed, bottom-tending gears, such as pots, traps, and sink gillnets, may be used in inshore SAV beds, but if so, their use is not federally-regulated. Thus, the vulnerability of juvenile and adult HAPCs to the effects of these gear types is not applicable. Since adults and juveniles are both opportunistic feeders, the vulnerability of EFH that is not designated as HAPC was rated as low for bottom trawls and dredges. Summer flounder eggs and larvae are pelagic, so EFH vulnerability is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability, and H = high vulnerability.

Table 6.38. Thorny skate EFH--vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Juveniles	GOM and GB	18-2000, mostly 111-366		Bottom habitats with a substrate of sand, gravel, broken shell, pebbles, and soft mud	M	M	0	L
Adults	GOM and GB	18-2000, mostly 111-366		Bottom habitats with a substrate of sand, gravel, broken shell, pebbles, and soft mud	M	M	0	L

Rationale: Thorny skate (*Amblyraja radiata*) range from Greenland south to South Carolina. In the Northeast Region, this species is most commonly seen in the GOM and on the Northeast Peak and in the northern portion of the Great South Channel of GB. It is one of the most common skates in the GOM, and occurs over a wide variety of bottom substrates, including sand, gravel, and broken shell to mud (Packer *et al.* 2003f). It is found at depths ranging from 18-1200 m, and is reported to be most common between 50-350 m. A single fertilized egg is encapsulated in an egg case. Females with fully formed egg cases have been captured year-round, though the percentage of mature females with egg cases is higher in the summer (Packer *et al.* 2003f). The primary prey of thorny skates are polychaetes and decapod crustaceans, followed by amphipods and euphausiids. Fish and mysids are also consumed in lesser quantities. According to a survey from Nova Scotia to Cape Hatteras, thorny skate prey varies with skate size. Skates less than 40 cm total length feed mostly on amphipods, skates greater than 40 cm fed on polychaetes and decapod crustaceans, and fishes were a major dietary component for skates larger than 70 cm. In general, with increasing size, mysids decreased in the diet while fishes increased (Packer *et al.* 2003f). Since juvenile thorny skate appear to be more reliant on benthic invertebrates, vulnerability of EFH to otter trawls and scallop dredges for this life stage was characterized as moderate. For adults, EFH vulnerability to otter trawls and scallop dredges was rated as none for juveniles and adults since there is no overlap between thorny skate EFH and areas in which clam dredges are used.

^a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

^b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1); NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.39. Tilefish EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b				
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps	Sink Gill Nets and Bottom Longlines
Eggs	U.S./Canadian boundary to Virginia/North Carolina boundary (shelfbreak: GB to Cape Hatteras)	76-365	Serial spawning from March to November; peaks during April to October	Water column	NA	NA	NA	NA	NA
Larvae	U.S./Canadian boundary to Virginia/North Carolina boundary (outer continental shelf: GB to Cape Hatteras)	76-365	February to October; peaks during July to October	Water column	NA	NA	NA	NA	NA
Juveniles	U.S./Canadian boundary to Virginia/North Carolina boundary (shelfbreak, submarine canyon walls, and flanks: GB to Cape Hatteras)	76-365	All year; may leave GB in winter	Rough bottom, small burrows, and sheltered areas; substrate rocky, stiff clay, human debris	H	L	0	L	L
Adults	U.S./Canadian boundary to Virginia/North Carolina boundary (shelfbreak, submarine canyon walls, and flanks: GB to Cape Hatteras)	76-365	All year; may leave GB in winter	Rough bottom, small burrows, and sheltered areas; substrate rocky, stiff clay, human debris	H	L	0	L	L

Rationale: Tilefish (*Lopholatilus chamaeleonticeps*) are restricted to the continental shelf break south of the GOM (Steimle, Zettlin, Berrien, Johnson, and Chang 1999b). They occupy a number of habitats, including scour basins around rocks or other rough bottom areas that form burrow-like cavities, and pueblito habitats in clay substrate. The dominant habitat type is a vertical burrow in a substrate of semi-hard silt-clay, 2-3 m deep and 4-5 m in diameter with a funnel shape. These burrows are excavated by tilefish; secondary burrows are created by other organisms, including lobsters, conger eels, and galatheid crabs. Tilefish are visual daytime feeders on galatheid crabs, mollusks, shrimps, polychaetes, and occasionally fish. Mollusks and echinoderms are more important to smaller tilefish. Little is known about juveniles of the species. A report to the Mid-Atlantic Fishery Management Council (Able and Muzeni 2002) from a video survey in areas of tilefish habitat identified trawl tracks through these areas, and concluded that trawling caused a resuspension of bottom sediments. The report noted that resuspended sediments fill burrows in and/or cause physiological stress to tilefish. No obvious structural impacts to the habitat were identified. However, due to the tilefish's reliance on structured shelter and the need for further study, the vulnerability of tilefish EFH to otter trawls was ranked as high. Clam dredges operate in shallow, sandy waters typically uninhabited by tilefish, so EFH vulnerability was rated as none for this gear. Scallop vessel monitoring data (Chapter 4) indicate that scallop dredges operate to a small extent in areas overlapping tilefish EFH; therefore, EFH vulnerability to scallop dredges was ranked as low. Tilefish eggs and larvae are pelagic; therefore, EFH vulnerability is not applicable.

^a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

^b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.40. White hake EFH-vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GOM, GB, SNE, and the following estuaries: Great Bay to Cape Cod Bay		August to September	Surface waters	NA	NA	NA	NA
Larvae	GOM, southern edge of GB, SNE to middle Atlantic, and the following estuaries: Massachusetts Bay to Cape Cod Bay		May in mid-Atlantic area, August and September in GOM, GB area	Pelagic waters	NA	NA	NA	NA
Juveniles	GOM, southern edge of GB, SNE to middle Atlantic, and the following estuaries: Passamaquoddy Bay to Great Bay, and Massachusetts Bay to Cape Cod Bay	5-225	May to September	Pelagic stage=pelagic waters; demersal stage=bottom habitat with seagrass beds or substrate of mud or fine-grained sand	M	M	0	L
Adults	GOM, southern edge of GB, SNE to middle Atlantic, and the following estuaries: Passamaquoddy Bay to Great Bay, and Massachusetts Bay to Cape Cod Bay	5-325		Bottom habitats with substrate of mud or fine-grained sand	L	L	0	L
Spawning adults	GOM, southern edge of GB, SNE to middle Atlantic	5-325	April to May, southern part of range; August to September, northern part of range	Bottom habitats with substrate of mud or fine-grained sand in deepwater	L	L	0	L

Rationale: White hake (*Urophycis tenuis*) adults co-occur geographically with red hake, and their habits are similar, but white hake are distributed in a wider range of depths and temperatures (Chang, Morse, *et al.* 1999; Klein-MacPhee 2002a). They are found from Labrador south to North Carolina, and occasionally stray as far as Florida and Iceland. They inhabit coastal estuaries and occur across the continental shelf to the submarine canyons along the upper continental shelf, and in the basins of the GOM. Adult distribution in the region is focused in the GOM and along the southern slope of Georges Bank. All life stages are found in estuaries near the GOM (NEFMC 1998). Most pelagic juveniles cross the shelf and enter estuaries from Canada south to the Mid-Atlantic Bight, although some may also settle to the bottom in unknown shelf habitats (Klein-MacPhee 2002a). Demersal juveniles are found in nearshore waters out to a depth of about 225 m (Chang, Morse, *et al.* 1999). Eelgrass is an important habitat for juveniles, but its functional importance is unknown; this life stage is not necessarily dependent upon structure (Able and Fahay 1998). Young-of-the-year white hake feed mainly on shrimp, mysids, and amphipods. Since otter trawls and scallop dredges can negatively impact eelgrass (Stephan *et al.* 2000) in estuaries, vulnerability of juvenile white hake EFH to these gears was characterized as moderate. Hydraulic clam dredges are not utilized in estuaries of the GOM, so vulnerability to this gear was rated as none. Adults prefer benthic deposits of fine-grained sediments (Chang, Morse, *et al.* 1999). They feed primarily on fish, cephalopods, and crustaceans. Since they are not benthivores and have not been documented to use benthic habitats for cover, EFH vulnerability to otter trawls and scallop dredges was characterized as low. Clam dredges are not operated in areas of adult EFH, and vulnerability to this gear was rated as none.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.41. Windowpane EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GOM, GB, SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Passamaquoddy Bay to Great Bay, and Massachusetts Bay to Delaware inland bays	<70	February to November, peaks May and October in middle Atlantic, July to August on GB	Surface waters	NA	NA	NA	NA
Larvae	GOM, GB, SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Passamaquoddy Bay to Great Bay, and Massachusetts Bay to Delaware inland bays	<70	February to November, peaks May and October in middle Atlantic, July to August on GB	Pelagic waters	NA	NA	NA	NA
Juveniles	GOM, GB, SNE, middle Atlantic south to Cape Hatteras, and the following estuaries: Passamaquoddy Bay to Great Bay, and Massachusetts Bay to Chesapeake Bay	1-100		Bottom habitats with substrate of mud or fine-grained sand	L	L	L	L
Adults	GOM, GB, SNE, middle Atlantic south to Virginia/North Carolina border, and the following estuaries: Passamaquoddy Bay to Great Bay, and Massachusetts Bay to Chesapeake Bay	1-75		Bottom habitats with substrate of mud or fine-grained sand	L	L	L	L
Spawning adults	GOM, GB, SNE, middle Atlantic south to Virginia/North Carolina border, and the following estuaries: Passamaquoddy Bay to Great Bay, and Massachusetts Bay to Delaware inland bays	1-75	February to December, peak in May in middle Atlantic	Bottom habitats with substrate of mud or fine-grained sand	L	L	L	L

Rationale: Windowpane flounder (*Scophthalmus aquosus*) is distributed in coastal waters from the Gulf of St. Lawrence to Florida, and are most abundant on GB and in the New York Bight (Klein-MacPhee 2002b). Windowpane are abundant in estuaries from Maine through Chesapeake Bay (NEFMC 1998). They are a shoal-water fish, with a depth range of up to 200 m, but are most abundant in waters less than 50 m deep. Both juveniles and adults are found on muddy sediments in the GOM, and fine, sandy sediments on GB and in New England and the Mid-Atlantic Bight. Mysids are the main prey item of juveniles (Klein-MacPhee 2002b). Adults have been shown to feed exclusively on nekton and show little need for bottom structure (Chang, Berrien, Johnson, and Morse 1999). EFH vulnerability to the three types of mobile gear was rated as low for both these life stages. Windowpane eggs and larvae are pelagic, so EFH vulnerability to fishing gear is not applicable for these two life stages.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.42. Winter flounder EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GB, inshore areas of GOM, SNE, middle Atlantic south to Delaware Bay and the following estuaries: Passamaquoddy Bay to Delaware inland bays	<5	February to June, peak in April on GB	Bottom habitats with a substrate of sand, muddy sand, mud, and gravel	L	L	L	L
Larvae	GB, inshore areas of GOM, SNE, middle Atlantic south to Delaware Bay and the following estuaries: Passamaquoddy Bay to Delaware inland bays	<6	March to July, peak in April and May on GB	Pelagic and bottom waters	L	L	L	L
Juveniles	GB, inshore areas of GOM, SNE, middle Atlantic south to Delaware Bay and the following estuaries: Passamaquoddy Bay to Chincoteague Bay	0.1-10 (1-50, age 1+)		Bottom habitats with a substrate of mud or fine-grained sand	L	L	L	L
Adults	GB, inshore areas of GOM, SNE, middle Atlantic south to Delaware Bay and the following estuaries: Passamaquoddy Bay to Chincoteague Bay	1-100		Bottom habitats including estuaries with substrates of mud, sand, gravel	M	M	M	L
Spawning adults	GB, inshore areas of GOM, SNE, middle Atlantic south to Delaware Bay and the following estuaries: Passamaquoddy Bay to Delaware inland bays	<6	February to June	Bottom habitats including estuaries with substrates of mud, sand, gravel	M	M	M	L

Rationale: Winter flounder (*Pseudopleuronectes americanus*) range from Labrador to Georgia, and are most abundant from the Gulf of St. Lawrence to Chesapeake Bay (Klein-MacPhee 2002a). Juveniles and adults are found in waters less than 100 m deep, and most are found from shore to 30 m. They range far upstream in estuaries, and have been found in freshwater. Winter flounder lay demersal adhesive eggs in shallow water less than 5 m in depth, with the exception of spawning areas on GB and Nantucket shoals (Pereira *et al.* 1999). Substrates include sand, muddy sand, mud, and gravel, with sand the most common. Although otter trawls, scallop dredges, and clam dredges may affect the eggs directly, this was not considered a habitat impact. Since there is no indication that the eggs rely on any structure, egg EFH vulnerability to these three gears was rated as low. Since early stage larvae are associated with the bottom and are at times demersal (Able and Fahay 1998), larval EFH vulnerability to all gears was also rated as low instead of none. Juvenile and adult winter flounder are found on mud and sand substrates, and adults are seen on cobble, rocks, and boulders (Pereira *et al.* 1999). Both life stages can be opportunistic feeders, however, their main prey items are infaunal invertebrates. Because of their reliance on infauna and their ability to use alternative food supplies, EFH vulnerability to the three mobile gear types for these life stages was ranked as moderate.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1); NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; H = high vulnerability.

Table 6.43. Winter skate EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Juveniles	Cape Cod Bay, GB, SNE shelf through Mid-Atlantic Bight to North Carolina; includes estuaries from Buzzards Bay south to Chesapeake Bay	0-37, mostly <111		Bottom habitats with substrate of sand and gravel or mud	M	M	M	L
Adults	Cape Cod Bay, GB SNE shelf through Mid-Atlantic Bight to North Carolina; includes estuaries from Buzzards Bay south to Chesapeake Bay	0-371, mostly <111		Bottom habitats with substrate of sand and gravel or mud	M	M	M	L

Rationale: Winter skate (*Leucoraja ocellata*) are found from Newfoundland south to Cape Hatteras. They are most abundant on GB and in coastal waters south to the mouth of the Hudson River. They are found over substrates of sand, gravel, and mud, in depths from shore out to 371 m, and are most common in <111 m of water (Packer *et al.* 2003g). Females deposit single fertilized eggs in egg capsules, which are deposited on the bottom during summer in the northern portion of the range. Deposition has been reported to extend through January off SNE. Young are fully developed at hatching (Packer *et al.* 2003g). Polychaetes and amphipods are the most important prey items, followed by decapod crustaceans, isopods, bivalves, and fish. In general, crustaceans make up over 50% of the diet for skates smaller than 61 cm, and fish and bivalves are a major component of the diet for skates larger than 79 cm (Packer *et al.* 2003g). Crustaceans generally declined in importance with increasing skate size, while polychaetes increased, until skates reached 81 cm. Since juvenile winter skate appear to be more reliant on benthic invertebrates, vulnerability of EFH to mobile gear for this life stage was characterized as moderate. For adults, EFH vulnerability to mobile gear was characterized as moderate because of their reproductive habits.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.44. Witch flounder EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b		
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge
Eggs	GOM, GB, continental shelf off SNE, and middle Atlantic south to Cape Hatteras	Deep	March to October	Surface waters	NA	NA	NA
Larvae	GOM, GB, continental shelf off SNE, and middle Atlantic south to Cape Hatteras	Deep	March to November, peaks from May to July	Surface waters	NA	NA	NA
Juveniles	GOM and outer continental shelf from GB south to Cape Hatteras	50-450		Bottom habitats with fine-grained substrate	M	L	0
Adults	GOM and outer continental shelf from GB south to Chesapeake Bay	25-300		Bottom habitats with fine-grained substrate	M	L	L
Spawning adults	GOM and outer continental shelf from GB south to Chesapeake Bay	25-360	March to November, peaks from May to August	Bottom habitats with fine-grained substrate	M	L	L

Rationale: Witch flounder (*Glyptocephalus cynoglossus*) range from Newfoundland south to Cape Hatteras. In U.S. waters, this species is common throughout the GOM, and is found in the deeper areas of and adjacent to GB and along the continental shelf edge and upper slope (Cargnelli, Griesbach, Packer, Berrien, Morse, *et al.* 1999, Klein-MacPhee 2002d). Juvenile and adult witch flounder are found mainly over fine muddy sand, or mud. Their diet is comprised mainly of polychaetes, and they feed on other invertebrates as well (Cargnelli, Griesbach, Packer, Berrien, Morse, *et al.* 1999). Since these life stages occur in areas of lower natural disturbance and rely on infauna, EFH vulnerability to impacts from otter trawls were rated as moderate. Impacts from scallop dredging may be less severe, since scallop dredges are not usually used in muddy habitat; however, vessel trip reports indicated scallop dredging in areas of witch flounder EFH (see Chapter 4 of this document). Therefore, vulnerability to scallop dredges was rated as low. Juvenile EFH vulnerability to clam dredges was rated as none since clam dredges are not used in mud or in water depths where juvenile witch flounder are primarily found. However, EFH vulnerability to clam dredges for adults was rated as low since clam dredges do operate in adult EFH. Eggs and larvae of witch flounder are pelagic, so vulnerability of EFH to fishing gear impacts is not applicable.

a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.

Table 6.45. Yellowtail flounder EFH -- vulnerability to effects of bottom-tending fishing gears and rationale for evaluations

Life Stage	Geographic Area of EFH ^a	Depth (m)	Seasonal Occurrence	EFH Description	EFH Vulnerability ^b			
					Otter Trawl	New Bedford-Style Scallop Dredge	Hydraulic Clam Dredge	Pots and Traps
Eggs	GB, Massachusetts Bay, Cape Cod Bay, SNE continental shelf south to Delaware Bay, and the following estuaries: Passamaquoddy Bay to Saco Bay; Great Bay to Cape Cod Bay	30-90	Mid-March to July, peaks in April to June in SNE	Surface waters	NA	NA	NA	NA
Larvae	GB, Massachusetts Bay, Cape Cod Bay, SNE continental shelf, middle Atlantic south to Chesapeake Bay, and the following estuaries: Passamaquoddy Bay to Cape Cod Bay	10-90	March to April in New York Bight; May to July in SNE and southeastern GB	Surface waters	NA	NA	NA	NA
Juveniles	GB, GOM, SNE continental shelf south to Delaware Bay, and the following estuaries: Sheepscot R., Casco Bay, Massachusetts Bay to Cape Cod Bay	20-50		Bottom habitats with substrate of sand or sand and mud	M	M	M	L
Adults	GB, GOM, SNE continental shelf south to Delaware Bay, and the following estuaries: Sheepscot R., Casco Bay, Massachusetts Bay to Cape Cod Bay	20-50		Bottom habitats with substrate of sand or sand and mud	M	M	M	L
Spawning adults	GB, GOM, SNE continental shelf south to Delaware Bay, and the following estuaries: Massachusetts Bay to Cape Cod Bay	10-125		Bottom habitats with substrate of sand or sand and mud	M	M	M	L

Rationale: Yellowtail flounder (*Limanda ferruginea*) are found from the Gulf of St. Lawrence south to the Chesapeake Bay (Johnson *et al.* 1999; Klein-MacPhee 2002d). They are most abundant on the western half of GB, western GOM, east of Cape Cod, and off SNE (Johnson *et al.* 1999). Their usual depth range is from 10-100 m (Klein-MacPhee 2002d). Juveniles and adults are found in some New England estuaries, while eggs and larvae are found more frequently in these habitats (NEFMC 1998). Yellowtail eggs and larvae are pelagic, so EFH vulnerability is not applicable. Yellowtail flounder feed mainly on benthic macrofauna, primarily amphipods and polychaetes (Johnson *et al.* 1999). Adults eat mostly crustaceans while juveniles focus on polychaetes. Both life stages are found on substrates of sand or sand and mud. Vulnerability of juvenile and adult EFH to the three types of mobile gear was rated as moderate because of the potential effect of these gears on infaunal yellowtail prey.

^a EFH Geographic Areas: GOM = Gulf of Maine; GB = Georges Bank; and SNE = Southern New England.

^b EFH Vulnerability Category (derived from the matrix analysis in Table 6.1): NA = not applicable; 0 = no vulnerability; L = low vulnerability; M = moderate vulnerability; and H = high vulnerability.